Barriers to selling livestock in the face of drought in the Omusati Region of North Central Namibia

Submitted by
Nivedita Joshi
JSHNIV001

Supervisor: Dr Dian Spear
Co-supervisor: Gina Ziervogel

September 2020

This thesis is presented as a partial requirement,
in addition to approved courses towards the
M.Sc. in Climate Change and Sustainable Development

Department of Environmental and Geographical Sciences
UNIVERSITY OF CAPE TOWN

Declaration of Authorship

I have read and understood the regulations governing the submission of an MSc dissertation, as contained in the rules of this University. I know the meaning of plagiarism and hereby declare that all of the work presented in this minor dissertation, save for that which is properly acknowledged, is my own.

Signature: Signed by candidate

Date: 5th September 2020

Abstract

Marginal communities living in semi-arid Namibia face significant challenges in sustaining rural livelihoods due to environmental degradation and poverty. Research has shown that livestock farming depends on rain-fed agriculture among other things, thus making communal farmers vulnerable to climate change in the future. Given this, it often makes sense for farmers to sell their livestock and explore alternative livelihood options. However, farmers in north-central Namibia are reluctant to sell their livestock despite a noticeable temperature increase and rainfall decrease over the past forty years. This study analyses the barriers to selling livestock in the face of a drought in the Omusati region of north-central Namibia. The study was carried out in three villages namely Omahanene, Okathitukeengombe and Oshihau, in the north-central Omusati region of Namibia. Household livestock distribution, perceptions of climate change, barriers to the sale of livestock and alternative livelihood strategies from other semi-arid regions were explored among 30 households using semi-structured household interviews and a systematic literature review. Results from the study indicate that 80% of communal farmers predict future droughts in the region and able to recall climate change through frequent droughts, increasing temperatures and decreasing rainfall. Farmers claimed that these changes have affected their livestock numbers. However, several barriers including cultural beliefs, lack of financial security, access to information, lack of institutional support and lack of efficient markets hinder livestock sales. The study suggests that the imminent impact of climate change coupled with the reluctance to sell livestock will threaten food security in the future. The study argues that rural livelihood diversification strategies are critical to safeguarding sustainable livelihoods in the future, including those of communal livestock farmers specifically. Additionally, policy recommendations like access to credit through public and private funding, access to markets by providing transportation facilities, encouraging market participation by improving quality of grazing lands, increasing water availability, building veterinary facilities, employing extension officers and access to information through reliable channels can help build a sustainable future in the face of climate risks.

Keywords: **Barriers to climate change adaptation, Livestock, Drought, Livelihood diversification, Namibia**

Acknowledgements

I would like to thank my supervisor Dian Spear for her timeous feedback, guidance and support during my Medical Leave of Absence as well as to ASSAR for the funding that made this research possible. Thank you to Gina Ziervogel for promptly stepping in as my co-supervisor. To my colleagues who have become great friends through our Masters' journey and to my caring course convener, Marieke Norton.

Thank you to my fieldwork team: Angela, Hileni and Efaishe for the wonderful experience. To my parents for their unwavering love, support and constant pep talks. To Neharika Prashant and Andrew for constantly encouraging me when I needed it the most, proof reading my work and listening to me complain. To my doctors, Dr Daswani, Dr Maravic and Dr Adil for helping me with my Trigeminal Neuralgia pain and Temporomandibular Disorder pain during this time.

Table of Contents

List of Acronyms

ASSAR	Adaptation at Scale in Semi-Arid Regions
BCR	Benefit-Cost Ratio
CBA	Cost Benefit Analysis
CBPP	Contagious Bovine Pleuropneumonia
FMD	Foot and Mouth Disease
GDP	Gross Domestic Product
IPCC	Intergovernmental Panel on Climate Change
MeatCo	Meat Corporation of Namibia
NACP	National Agricultural Credit Programme
NCA	North Communal Area
ORG	Open Rotational Grazing
SSA	Sub Saharan Africa
UCT	University of Cape Town
UNFCCC	United Nations Framework Convention on Climate Change
VCF	Veterinary Cordon Fence

List of Figures

List of Tables

Chapter One: Introduction

Livestock play a vital role in the lives of Aawambo communal farmers and are seen as "living assets" in the Aawambo culture. (Mendelsohn et al., 2000; Newsham and Thomas, 2009; Republic of Namibia, 2011; Spear et al., 2018). In case of emergencies, livestock are converted to cash and are also used as collateral for future endeavours (Shackleton et al., 1999). Additionally, owning livestock is closely associated with wealth, and livestock are traditionally used to strengthen social ties and as a measure of status in society (Ouma et al., 2003). Although the northern region of Namibia is home to 57% of the country's rural population, communal farmers face a plethora of challenges comprising land degradation, frequent droughts, deforestation and overgrazing, scarce water resources and poor land tenure systems, animal diseases and market shocks, which ultimately affect household incomes (Morton, 2007; Spear et al. 2015; Angula and Kaundjua, 2016).

Human beings have had a complex relationship with the environment - how we live within the environment, how we are influenced by it and how it shapes the world we live in. One aspect of the environment that influences most human communities directly is the myriad of changing weather conditions, known as climate (Davies, 2011). In low-income rural communities, climate plays a vital role in shaping the existence of communal farmers whose livelihoods rely on rainfall, like those in the focus of this study - Aawambo farmers of North Central Namibia. In recent years, climate change has exposed communities all over the world to aberrant living conditions (Leichenko and O'Brien, 2001). Although coping mechanisms are varied across scale, researchers suggest that the implications of climate change will be faced by the poorest countries in Sub Saharan Africa that are not equipped to deal with such radical changes (Adger, 2003; Ziervogel and Calder, 2003; O'Brien and Leichenko, 2003; Angula and Kaundjua, 2015)

Semi-arid environments are variable and harsh places to live, especially given the high temperatures and recurring droughts that Namibia has experienced over the past few decades (Newsham and Thomas, 2011; Republic of Namibia, 2011; Kaundjua, Angula and Angombe, 2012). Although subsistence livestock farming is a risk prone activity in semi-arid regions (Morton, 2007), Pritchart et al. (1992) state that semi-arid and arid regions are home to 57% of total livestock population in Africa. In fact, pastoralism plays an integral part in contributing to the socio-economic status of farmers south of the Sahel (Anon, 2018).

Historically, communal livestock farmers have coped with the impacts of climate by supplementing livestock feed, reducing herd sizes (Akinyemi, 2017), selling livestock, borrowing money from family members (Alemayehu and Bewket, 2017) and by adopting strategic mobility practices, where farmers move their livestock seasonally in order to find food for their animals (O' Farrell et al., 2009). The United Nations Framework Convention on Climate Change (UNFCCC), defines climate change as a "change of climate that is attributed directly or indirectly to human activity that alters the composition of global atmosphere and that is in addition to natural climate variability observed over comparable time periods". How the climate will change in future is of concern to the agriculture sector, as it is likely to result in significant impacts on forage, higher mortality rates and inaccessible clean water resources; thereby threatening livestock production and implicating livelihoods and food security for communal farmers in northern Namibia (Newsham and Thomas, 2009; Mutibvu et al., 2012; Barnes et. al, 2012; Thornton et al., 2015; Angula et al., 2016). Reid et al (2007) suggest that over a period of the next 20 years, the Namibian economy will suffer a significant loss (6%) in Gross Domestic Product (GDP) due to the impact of climate change. In terms of the livestock sector, in the next 70 years, it is possible that there may be an income decline of approximately 1% per annum that would result in production and growth losses of the country's net income (Reid et al., 2007). This will consequently affect the poorest communities the most (Reid et al., 2007).

Agriculture has always played an integral part in supporting rural livelihoods and economic growth in Sub Saharan Africa (SSA) and 97% of all farmland is supported by rain-fed agriculture exposing the continent to high seasonal rainfall variability (Shah et al., 2008; Calzadilla et al., 2008). According to Boko et al., (2007) the effects of future climate change will be felt across the continent through warming and a reduction in precipitation. Semi-arid regions could experience a 1.6 °C rise in temperature by 2050 (Ringius et al., 1996). Regardless of the trajectory, the negative impacts of climate change will drastically affect the livelihoods of rural agrarian communities around the world, including Sub Saharan Africa. There is an intrinsic need for communal livestock farmers in semi-arid regions, such as the Omusati Region in northern Namibia, to sell livestock and diversify rural livelihoods as an adaptive measure to climate change. By doing so, farmers can avoid some of the loss of long-term livestock investment. However, communal farmers are unwilling to sell given the multifaceted use of livestock and the direct and indirect value farmers receive from their animals (Shackleton et al., 2001). This resistance to selling livestock is making communal farmers in the Omusati

region extremely vulnerable, as they hold on to stock which eventually perishes when there is a drought.

Vulnerability and adaptation are concepts that have been prevalent in literature for decades, however, it is only recently that these concepts have become the main theme for global environmental discussions (Vogel et al., 2007). Vulnerability is the exposure to risks and shocks caused to a system through a variety of stressors. Adaptive capacity is the ability of the system to cope with these risks and shocks without compromising future needs (Brundtland et al., 1987; Chambers, 1989; Leichenko and O'Brien, 2002; Adger et al., 2003). In terms of climate change, adaptation refers to the adjustments made to a system in anticipation (or in the face) of climate perturbations (Smithers and Smit; 1997; Smit et al., 2000). Although adaptation strategies are derived from the vulnerabilities to climate change, the term vulnerability is quite complex in nature. In their study, Eakin and Luers (2006) suggest that vulnerability has been measured by sensitivity, exposure and adaptive capacity of a system. However, this measure is not enough and more emphasis should be laid on interdisciplinary expertise of global -environmental change, natural disasters and human-environment interactions which would enable a more thorough assessment of vulnerability (Eakin and Luers, 2006).

Having established that vulnerability is a multivariate process extending beyond physical effects of climate change, Thomas et al. (2018) highlights the need to recognize that social groups are not uniformly vulnerable to climate change and it is this disparity across society that exposes communities to varying degrees of sensitivity to climate variability. Climate variability in the future is likely to influence average weather patterns which will expose developing countries to extreme climate related events (Mirza, 2003). This will have a cascading effect on all sectors of society and poor economies will suffer great human and capital losses due to a lack of adaptive capacity (Mirza, 2003). In this study, communal famers who belong to the Omusati experience a semi-arid climate which is likely to exacerbate in the future making local communities vulnerable to climate change. Traditionally, these farmers are very attached to their livestock and are reluctant to sell their animals even during years of recurring drought. Given the physical factors of the region coupled with the unwillingness to shed traditional systems, it is vital to look at how these factors interact to make communities vulnerable in different capacities.

This thesis will first attempt to assess the purpose of livestock to the people of Omusati Region or North central Namibia in terms of livestock distribution among households and the value to communal farmers that makes it vital for them to hold on to their animals. Additionally, this thesis will attempt to understand local perceptions of current and future droughts, in terms of impact currently experienced and the viability of holding livestock given future climate projections. Düvel (1991) suggests that although perceptions are subjective by nature, like those of the communal farmer in this study, they are instrumental in informing behaviour change. Thus, there is clearly a need to understand the perception of communal farmers in the region. Such understanding will help bring forth logical interventions and opportunities for improving and exploring diverse livelihood options.

The concept of barriers to adaptation has gained momentum after being acknowledged in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. Barriers are defined as factors that hinder adaptation that can however be overcome with concerted effort (Barnett et al., 2015). With respect to adaptation strategies, Adger et. al (2007) define barriers as "configurations of climate and non-climate factors and conditions that emerge from the actor, the governance system, or the system of concern". In light of this information, the barriers to the sale of livestock will be assessed and alternative livelihood diversifying strategies from other regions will be explored. In order to do this, identifying different social and institutional actors is integral and moreover aiming to strengthen existing livelihoods of communal farmers in the Omusati Region is critical to this study.

1.1 Research Aim and Objectives

The aim of this thesis is to analyse the barriers to selling livestock in the face of a drought in the Omusati Region of North Central Namibia. In order to address the aim, three objectives and a number of research questions will guide the research:

Objective 1: Assess the purpose of livestock among communal farmers in the Omusati Region of North Central Namibia

1. How is livestock distributed among households in the Omusati Region?

2. Why is livestock integral to the lives of communal farmers?

Objective 2: Understand the perception of communal livestock farmers regarding current and future droughts with respect to the sale of livestock, the thesis will ask:

1. Do communal farmers perceive themselves to be vulnerable to climate change?
2. Is it viable for communal farmers to keep livestock? A cost benefit analysis

Objective 3: Analyse the barriers to selling livestock so as to improve the lives of communal farmers in the Omusati Region.

1. What are the barriers to selling livestock?
2. What are alternate livelihood diversification strategies adopted by communal farmers in semi-arid regions?
3. Are communal farmers in Onesi willing to try new practices?

The findings from this research contributed to the Adaptation at Scale in Semi-Arid Regions (ASSAR) research project in Namibia. The aim of ASSAR was to use interdisciplinary scientific research to understand the barriers and enablers of adaptation strategies in semi-arid regions. ASSAR has conducted research across numerous countries namely: India, Kenya, Ethiopia, Ghana, Mali, Botswana and Namibia.

Chapter Two: Literature Review

2.1 Livestock – a universal commodity

Grazing land for livestock covers 45% of the earth's surface (Reid et al., 2008). Livestock are considered key global assets for both rural and urban dwellers (Asner et al., 2004; Reid et al., 2008; Herrero et al., 2009). Livestock farmers' (commercial and communal) primary purpose of owning livestock has been to maximize the yield of consumable and non-consumable goods and services that livestock provide (Tapson, 1991). The main focus of commercial livestock farmers is to generate profit through sales; however, it is not as straightforward for communal livestock farmers who are neither commercially inclined nor can be categorized as subsistence farmers (De Lange, 1994; Sweet, 1998). According to Mmbengwa et al (2015), communal farmers are part of a simple commodity production system where they rely on family economy and employ unremunerative family as labour. Essentially, then, communal farmers are more inclined to rely on farming as a supplementary income source, unlike their commercial counterparts, who imbibe a capitalist profit maximization business philosophy (Mmbengwa et al., 2015). Communal livestock farming in developing countries is closely associated with improving rural livelihoods with the aspiration of increasing food security, providing nutrition, directly and indirectly improving rural incomes, increasing soil fertility and improving social ties (Tapson, 1991; Shackleton et al., 2001; Mayo and Swanepoel, 2010; Becker, 2015). Additionally, livestock are integral factors in risk reduction strategies and people in rural communities deliberately stress holding onto livestock as a means of insurance, typically selling their animals during household emergencies (Shackleton et al, 1999b).

According to Colvin (1985), the reasons for keeping livestock among communal farmers in developing countries are fairly similar across the board, however the relative value from livestock differ from place to place. For example, a study carried out by Dovie, Shackleton and Witkowski (2004) in Thorndale, a communal area in the Limpopo district, South Africa revealed that the most important use of cattle in this region was to plough arable fields followed by cash from sales and milk; goats were used for meat and were slaughtered during ceremonies. Another study carried out by Devendra and Thomas (2002) in Asia revealed that livestock were primarily used as draught power and manure in crop fields as part of a well-developed integrated crop-livestock farming system. Ortmann and King (2007) explain that these

differences could be influenced by a myriad of factors such as limited access to factors of production, access to credit and information, cultural differences, inadequate property rights and high transaction costs. These factors further challenge the livelihoods of small-scale farmers in developing countries (Ortmann and King, 2007). Tangible assets like livestock are seen as a store of wealth and as an income source in parts of rural Africa (Barrett et al., 2001). In parts of Kenya and Ethiopia, livestock are seen as a means of insurance among communal livestock farmers, thus accumulating stock is one method of providing insurance and reducing risks during times of wealth shocks (Peak and Barrett, 2001). Additionally, during times of drought, when food security is threatened, and crop yields are low, livestock are consumed as a means of sustenance (Freeman et al., 2008; Moyo and Swanepoel, 2010).

2.2 The importance of livestock to communal famers in Namibia

In the following section the multifunctionality of livestock for communal farmers, specifically in Namibia, is explored. It also addresses farmer perceptions of climate change, the challenges associated with keeping livestock for communal farmers and the barriers to the sales of livestock.

The livestock industry accounts for roughly 11% of Namibia's gross domestic product (GDP) and 90% of Namibia's agricultural production comes from this industry (Naziri et al., 2005). There are two predominant cattle production systems in Namibia, namely freeholder or commercial farming and traditional or communal farming (Bishu and Kamwi, 2008). An estimated 150,000 households own smaller well-adapted indigenous Sanga cattle and utilize communal lands where communal farmers exercise legal grazing and breeding rights (Bishi and Kamwi, 2008). 50% of Namibia's total livestock is produced in north central Namibia, however merely 2% of this is sold in formal markets (Verlinden and Kruger, 2007). This could possibly be because marketing livestock in communal areas is typically motivated by a distress situation that demands immediate cash and not by a planned marketing and production system (Bruyn et al., 2001). Another reason for this could be the restriction put forth on the North Communal Areas (NCA) by the Veterinary Cordon Fence (VCF), or Red Line which was established in order to restrict the mobility of beef from the north of the VCF, which is essentially the NCA (Naziri et al., 2005).

The rural population of Namibia is composed of a varied mix of commuters, pensioners, civil servants, small business owners and the unemployed (De Lange, 1994) who tend to

supplement their formal cash incomes from non-agricultural activities with communal livestock farming and agriculture (May et al, 1995; Cousins, 1999; Musaba, 2010). Communal livestock farming is a vital contributor to household incomes, investment, food security and the alleviation of poverty in rural Namibia (Ministry of Agriculture, Water and Rural Development, 1995). According to Musaba (2010), livestock play an integral socio-economic role in the lives of communal farmers in Namibia and these farmers depend directly or indirectly on livestock for their livelihoods. Due to their multifunctional nature, livestock serve as a means of sustenance in rural communities and provide draught power, manure, meat, milk and cash from sales to small-scale communal farmers (Moyo et al., 2010; Naziri et al., 2015). Risk aversion is a predominant theme discussed in literature on rural farming behaviour (Eswan and Kotwal, 1989). According to Togarepi, Thomas and Kankono (2016), cattle are synonymous with a 'wealth bank' to communal farmers in north-central Namibia and the general tendency then is to hold on to these animals as financial security. Communal farmers use livestock to pay off their debts and as means of barter (Bayer, et al., 2003). In addition, livestock serve as collateral against unforeseen natural calamities (Dovie et al.,2006; Shackleton et al., 1999). One such example is the famine between the late 80s and early 90s that has been vividly etched in the minds of the Aawambo people and the experience of this unfortunate event has been passed down to future generations of communal farmers. As an outcome of this, future generations resort to holding on to their animals as a source of security and also growing their herds. They have been taught to believe in future security endeavours rather than short term monetary gains from selling their livestock (Mendelsohn et al., 2000).

2.3 Challenges to keeping livestock

2.3.1 Availability of feed

Namibia's north-central region is characterized by vegetation that is a mixture of Mopane Savannah, Forest Savannah and Woodlands that grow mostly in Arenosols (NARIS, 2001; Verlinden and Kruger, 2006). Traditionally, communal farmers kept their livestock close to their homestead from the onset of the rainy season to the onset of the dry season and thereafter transferred them to cattle posts (Williams, 1991). In recent times, 41% of the country's farmland is classified as state owned and all rural livestock related activities like breeding and rearing are curtailed to these areas (Verlinden and Kruger, 2006; Barnes et al., 2012). Communal rangelands are mainly open access thus, giving individuals unlimited access

to a common good; in this case grazing land. Consequently, this leads to the longstanding problem of the "tragedy of the Commons", where Hardin (1968), exemplifies a situation in which individuals act independently, motivated by personal gain, to deplete a stock of non-renewable resources from a common pool in the short run without appropriate management of the commons. Evidence of this phenomenon is seen in a study conducted by Klitenberg, Seely and Christiansson (2006) where respondents indicated from experience that the availability of grazing areas have diminished significantly after 1990 due to an increase in farmers and livestock numbers. Additionally, existing vegetation is being rapidly taken over by desert and arid shrubland (Midgey et al., 2005) further adding to the problem of inadequate livestock feed. Although Hardin wrote "the tragedy of the commons" in the late sixties, we can see the effects of this can be a primary cause of overgrazing in the northern communal areas of Namibia.

2.3.2 Water Availability

Given that Namibia receives limited and sporadic rainfall, problems such as evaporation from dams, unpredictable groundwater recharge rates and a growing population immensely stress this country's water supply (DWA, 1991; Sweet, 1998). Furthermore, with just two main perennial rivers in the north and the south, the country is heavily dependent on groundwater (Sweet, 1998). According to Vinge and Whiteside (1997), farmers face an additional problem of low groundwater levels as most of the water is diverted towards industrial and mining sites. In communal areas, livestock farmers tend to be situated near permanent water resources making their livelihoods extremely dependent on the natural water supply system (Sweet, 1998). When there is a lack of water, communal livestock farmers opt to migrate with their animals to better grazing areas in order to find water resources away from their homestead; hand dug wells near homesteads are usually prioritized for human consumption (Mendelsohn et al., 2000). During this time, wealthier livestock owners with approximately 20-30 animals move their cattle to lush cattle posts with adequate water and employ a herd boy to look after their animals. However, for other poor communal farmers water scarcity can be a major constraint. Poorer livestock farmers try to overcome this obstacle by pooling their resources together with other communal farmers so as to form a sizable herd and then traveling to a cattle post where they divide the livestock responsibilities among themselves (Mendelsohn et al., 2000).

2.3.3 Environmental change and Climate Change

Climate change is one of the greatest perils of our time and has extensive consequences (UNDP, 2015). Results from 25 years of data collected across Namibia by Newsham and Thomas (2009) show an increase in the frequency of warm days as well as an increase in maximum temperature. Additionally, Barnes et al (2012) suggest a rise of 3°C and 4°C in the annual mean temperature of Namibia by 2080. This increase in temperature could mean an increase in evaporation rates and could make livestock highly prone to heat stresses, disease and drought (Reid et al., 2008; Spear and Chappel, 2018). Consequently, this is bound to affect rural communities who are dependent on livestock for their supplementary livelihoods and food security (Spear and Chappel, 2018). With respect to precipitation, Davis (2011), posits that average winter rainfall across Namibia will decrease by approximately 6 mm by mid-century and 7 to 9 mm by the end of the century; summer rainfall is expected to decrease by approximately 17-23 mm by mid-century and 19 to 40 mm by the end of the century.

Historically, the drought in 1992 wiped out a significant amount of livestock in north-central Namibia and subsequently endangered the livelihoods and food security of the people in the region (Devereux et al., 1995). Unpredictable weather conditions and irregular rainfall patterns often threaten the livelihoods of poor farmers (Meissner et al., 2013). In the case of the 1992 tragedy, farmers could not predict the length of the drought and the repercussions of this were seen in the deteriorating health of their animals (Sweet, 1998). This time saw the biggest dip in livestock numbers and therefore in household incomes. During this period, cattle mortality rates were quite high which greatly affected the sale of livestock in the communal sector. Communal livestock farmers were forced to resort to distress sales that helped them earn money to buy food during this time. The people of north-central Namibia suffered a 28% decrease in monthly income and the mean household income went from N$ 706/month to N$ 504/month. Approximately 200 households in the area confirmed that they had no income during the drought and were supported by themselves by borrowing funds from relatives and selling non-animal assets (Devereux et al., 1995).

2.3.4 Stock Theft

Although there is an absence of literature on stock theft, a few studies indicate that livestock theft is emerging as a major concern as it appears to be a drain on wealth among communal farmers (Groenewald and Jooste, 2012; Hangara et al., 2011). Cattle identification

is integral to Namibia's statutory requirements. Communal farmers identify their stock by branding, tattooing and ear tagging. Nevertheless, this has proved to be ineffective in preventing livestock losses (Hangara et al., 2011). Problems such as inefficient cattle managerial practices, record keeping and identification further exacerbate the livestock theft problem among cattle farmers and can be minimized with proper access to knowledge and training from extension and veterinary officers (Metzger, 1994).

2.4 Perceptions of climate change and response to vulnerabilities

Though there is evidence of climate change significantly affecting inhabitants across the globe, research indicates that it is still not always a primary concern for most (Whitmarsh, 2008). Perceptions of climate change are shaped by personal experiences, perceived responsibility of the problem, perceived ownership of the problem, memories of the climatic event, cultural biases and belief systems (Patt and Schroeter, 2008). A study conducted on farmers' perceptions and responses by Wiid and Ziervogel (2012) in the Little Brak River area in the Western Cape Province, South Africa establishes a relationship between changing climate and farmer experience. Results from the study reveal that daily experiences of locals with changing climate do not only coincide with recorded scientific weather data but have also helped farmers in the Little Brak River area to comprehend future climate risks (Wiid and Ziervogel, 2012). Therefore, though scientific knowledge is imperative in the understanding of large-scale weather and climate averages, this process is often rendered incomplete without the inclusion of farmer perceptions (Hartel and Pearman, 2010; Becken et al., 2013).

Literature on people's perception of vulnerabilities highlights that climate change risks are psychologically distant; implying that experiences are based on the here and now (Liberman et al., 2008; Spence et al., 2012). This suggests that farmers who trust that the climate is changing and perceive this change as a threat to their livelihoods, are likely to respond and implement climate change adaptation strategies (Howden et al., 2007). However, this is not as straightforward in semi-arid regions like that of northern Namibia, where communal farmers are frequently exposed to variability in their local climate. As a result of climatic fluctuations, these farmers find it exceedingly hard to decipher weather patterns and are less likely to respond to climate change risks, thereby increasing their vulnerability (Shackleton et al., 2015). On the other hand, Adger et al. (2003) argue that adaptation to climate change in developing countries is in fact largely governed by past experiences of climate related risks. In a study conducted by Silvestri et al. (2012), in seven districts in Kenya's arid, semi-arid, temperate and

humid agro ecological zones, it was observed that farmers that had a greater farming experience reported a long-term decrease in rainfall and overall changes in rainfall variability. Additionally, 33% of farmers in semi-arid regions confessed that the main reason for feed inconsistency was the drought and climate change was acknowledged as the main reason for herd reduction (Silvestri et al., 2012). Based on the aforementioned scenarios, it is then plausible that adaptation hinges largely on people's perceptions; irrespective of psychological distance and past experiences.

2.5 Barriers to selling livestock in Namibia

Recent literature on "barriers" is both fragmented and in its nascent stages, but a clear conceptualization of barriers is crucial to the process of adaptation (Biesbroek et al., 2013). However, barriers are observed to be unique in their nature and vary across sectoral, spatial and temporal spaces; then a broad simplification of barriers would be dispensable (Biesbroek et al., 2013). Jones and Boyd (2011) defined barriers as to 'how each … [cognitive, normative, institutional] … facet … restrict individuals or groups from seeking the most appropriate or most sustainable forms of adaptation action'. Cognitive barriers relate to an individual's perception and knowledge of climate change, which subsequently influences their ability to adapt to current and future climate risks. Normative barriers relate to the influence of social and cultural 'norms' and the role they play on an individual's decision-making process. Institutional barriers relate to how organizations and institutions govern, enable and, in some cases, disable individuals' capacity and their ability to adapt to climate change (Lorenzoni et al., 2007; Jones and Boyd, 2011). In this particular study of northern Namibia, Jones and Boyd's (2011) analytical framework is used to investigate the barriers to selling livestock in northern Namibia. Barriers that inhibit people from selling livestock in the Omusati Region may be categorized many ways, with Figure 1 showing how barriers are conceptualised for this study. However, this is by no means an extensive list.

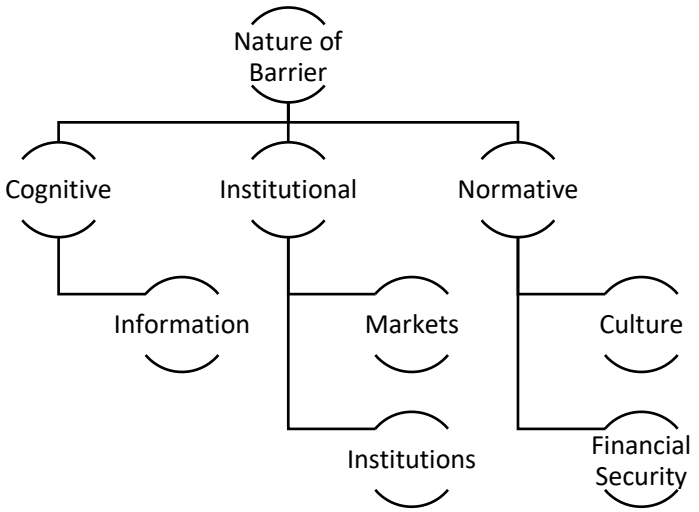

Figure 1: Barriers to selling livestock developed by the researcher adapted from the literature (Jones and Boyd (2011))

2.5.1 Information

Communal livestock farmers do not have access to the services necessary to produce high standards of livestock. These include rangeland management, veterinary services for animal care and disease control, markets for destocking, credit and loan facilities and information about market rates (Speir, et al., 2007; Mendelsohn, 2000; Mendelsohn, 2006; Montshwe, 2006; Musemwa et al., 2008). Relevant market information can help communal farmers take informed decisions while selling their livestock. These include identifying potential buyers and sellers, enforcing contracts and understanding market preferences and prices (Hangara et al., 2011). Practices like breeding, weaning, selection, vaccinations and parasite control that are integral to livestock farming are not carried out by communal farmers. According to Shiimi, Taljaard and Jordaan (2012), communal farmers in north-central Namibia lack accessibility to market information and current information technology. Due to this, they try to procure this information from a trusted informer in their community and other informal channels that might not always be dependable and detrimental to making profitable livestock sales (Togarepi et al., 2016; FAO, 2004).

2.5.2 Markets

The main livestock marketing channels are formal and informal channels (Nkosi and Kirsten, 1993). Formal marketing channels comprise abattoirs and auctions; informal

marketing channels comprise communal farmers in the vicinity, relatives and informal traders in the community (Düvel & Stephanus, 2000; De Bruyn et al., 2001). The decision to sell in formal or informal markets depends primarily on the transaction cost of the sale. Transaction costs in the communal livestock marketing sector incurred by individuals involve transporting and selling their livestock to markets, procuring trading partners and having the appropriate skill set to negotiate livestock prices. It is natural then that communal farmers deter from selling their animals in formal markets when transaction costs are high which is reiterated by Delgado (1999) as quoted in Jari and Fraser (2012), identified "high transaction costs as the embodiment of market access barriers among resource poor smallholders". Prior studies have shown that most communal farmers prefer to use informal channels to market their livestock (Nkosi and Kirsten, 1993; Sweet 1998; Düvel & Stephanus, 2000; De Bruyn et al., 2001; Shiimi, et al., 2012; Togarepi, et al., 2016). A major reason for this could be the lack of formal markets in the vicinity and also the distance they have to travel to get to formal markets (Togarepi, et al., 2016; De Bruyn et al., 2001). Another reason for this could be the poor condition of livestock in communal areas. In most cases auctioneers are concerned with the age and size of the livestock and are not willing to pay competitive prices for animals that are too small or too old (Coetzee et al., 2005).

While talking about the marketing constraints that northern communal farmers face, it is of prime importance to mention the Veterinary Cordon Fence (VCF) that virtually separates the northern communal farmers from the southern commercial farmers. Cordon fences have been used throughout Southern Africa to control the spread and transmission of infectious diseases among livestock in order to ensure disease free zones in beef-exporting nations (Thomson, 1999). As mentioned earlier, the farmers of north-central Namibia have been denied the privilege to farm for profit since the VCF or the red line came into existence in the 1960s. It runs from Palgrave Point to the West Coast through Oshivelo to the Namibia- Botswana border (Van der Linden, 1992; Düvel, 2002; Togarepi et al., 2016). The VCF is a regulatory mechanism that ensures meat and livestock cannot pass freely through the VCF to the southern Foot and Mouth Disease (FMD) free zone unless they have spent a period of twenty-one days in quarantine camps and have been inspected for diseases like Foot and Mouth disease (FMD) and Contagious bovine pleuropneumonia (CBPP) (Sweet, 1998; Düvel & Stephanus, 2000). This tedious inspection process and the distance from communal farms and sale points diminishes the value of their stock and deters the communal farmer from participating in formal

markets. Moreover, during a drought, when food is already short, and animals are weak, traveling over long distances further frails the animals (Nkosi and Kirsten, 1993).

2.5.3 Institutions

The objective of this section is to identify institutional constraints faced by communal farmers that deter them from participating in livestock sales. Formal Institutions like Meatco and Farmers' Union were devised to help human beings create a sense of order and reduce uncertainty in transactions. They comprise formal and informal institutions, where organizations and markets are classified under formal systems and social norms and traditions are considered informal systems (North, 1990; Kherallah and Kirsten, 2010). In the communal farming sector, farmers face institutional barriers such as poor infrastructure and transaction costs (Hangara et al., 2011; Jari and Fraser, 2012). A prerequisite for efficient integrated markets is that all the market mechanisms run smoothly and in tandem with each other. A lack of infrastructure and poor transportation hampers this process and leads to higher transaction costs thereby reducing the seller profit margins (Ouma et al., 2003). Communal farmers in Namibia face challenges of uncoordinated supply chain management, and high transportation costs of traveling to markets. In addition to this, they are lack access to good roads (Mendelsohn, 2006; Hangara et al., 2001; Shiimi et al., 2012). Efficient transportation systems are vital to livestock marketing, and a lack thereof can potentially increase farmers' reluctance to sell their livestock (Montshwe, 2006). Poor Infrastructure with regard to inaccessible networks of good roads and holding facilities is a factor that exacerbates the problems of communal farmers when it comes to selling their livestock (Bailey et al., 1999; Mendelsohn, 2006).

2.5.4 Culture

Culture shapes the way people understand, assimilate, experience and respond to their environments and cultural beliefs can act as a barrier to adaptation to climate change (Becken et al., 2013). An account of the deep-rooted historical tradition of cattle being used as a store of wealth is seen in Einzig's (1949) and Cunningham's (1997) work in north-central Namibia. Although a number of questions regarding the origin of this belief have not yet been answered, scholars suggest that cattle were seen as a symbol of wealth and prestige in the Aawambo community. Cattle were used as bride money during weddings, as financial security to pay debts, as a general medium of barter and labour, for milk and meat during funerals and

weddings and other unforeseen emergencies (Einzig, 1949; Cunningham, 1997; Togarepi et al., 2016; Musemwa et al., 2007; Sweet, 1998; Tapson & Rose, 1984). The traditional house of the Aawambo people have approximately 6 cattle and 12 goats. However, it is not uncommon to see farmers own larger stocks. These farmers having been previously employed by government institutions and trading companies received larger incomes which assisted them in procuring more livestock. Thus, they were perceived as wealthier and of higher social stature (Newsham and Thomas, 2011). Farming activities in the Aawambo culture are split between genders; men look after livestock and women are in charge of crop farming (Newsham and Thomas, 2011). As a result of this, male-headed households have more livestock than female headed households, and culturally, when a male member in the household passes on, his cattle is inherited by his relatives and not by his wife (Mendelsohn et al., 2000).

Though there is a dearth of literature on the culture of the Aawambo people of the Omusati Region, a review of empirical literature elaborates that livestock are integral socio-economic assets in agro-pastoralist communities in parts of Africa. Musemwa, Mushunje, Chimonyo, Fraser, Mapiye and Muchenje's (2008) work suggests that cattle are integral to the lives of communal farmers in South Africa and not only represent a symbol of stature, but also are used as draught power, for manure and for fuel (Shackleton et al., 2006; Bayer et al., 2004; Musemwa et al., 2008). Findings from a study carried out by Ouma, Gideon, Obare, Steven and Staal (2003), analysed data of two hundred and fifty cattle farmers in Kenya and indicated that social and cultural values linked to livestock are noteworthy in the communal farming sector. Much like in north-central Namibia, cattle in Kenya are a representation of social and economic status (Musemwa et al., 2008; Ouma et al., 2003) and are used during weddings and funerals, to settle disputes, as gifts, bride money and to strengthen social ties (Bayer et al., 2004; Musemwa et al., 2008; Ouma et al., 2003). A recent report on Vulnerability and Risk Analysis (VAR) in the Omusati Region, Namibia suggests that this tradition has been passed on through generations and even today, owning livestock is an integral part of the Aawambo culture. Furthermore, this is especially seen in older livestock farmers who are reluctant to sell their livestock during periods of drought (Hegga et al., 2016).

2.5.5 Financial Security

Communal farmers in the north-central part of Namibia resort to cattle sales during emergencies in order to procure funds for other pressing matters in the household (Nkosi and Kirsten, 1993). Problems surrounding credit and land tenure are commonplace among

communal livestock farmers and a deficit of knowledge regarding legal and financial rights further aggravate these problems (Kaakunga and Ndalikokule, 2006). A lack of agricultural assistance and failed schemes have severely affected the selling of livestock in communal areas (Montshwe, 2006). A primary example of one such failed scheme is the AgriBank scheme launched by The National Agricultural Credit Programme (NACP). In Namibia, communal livestock farmers are not entitled to own land and have also been excluded from access to credit. In order to overcome this barrier, the NACP (1995) launched the AgriBank scheme to facilitate the growth and development of farming in the communal sector. Unfortunately, this initiative did not succeed because of inefficient planning and execution of the program. Capacity building in terms of staff development, training and communication was one of the biggest shortcomings of this program. In addition to this, loans were predominantly available to wealthy farmers and communal farmers were still denied access to loans. Given this grim scenario, it should come as no surprise that communal farmers in north-central Namibia then choose to hold to on their livestock as financial security. Having no access to social grants, cash incomes and other livelihood opportunities, livestock farmers resort to holding on to their cattle during a drought without accounting for the tedious maintenance of the animals when resources are scarce (Angula and Kaundjua, 2016; Sweet, 1998). In hindsight, researchers believe that existing problems coupled with the effects of future climate change will significantly increase the livelihood and social vulnerability of communal farmers in the region (Shah et al., 2013)

2.5.6 Livelihood Diversification as a Way Forward

Looking at livelihoods through an "impact" lens reveals a myriad of factors other than climate change that affects people's lives in climate change hotspots like semi-arid regions. Extreme climate events, such as droughts are not only caused by high rainfall variability, but are often exacerbated by human induced activities such as unsustainable land-use patterns including overgrazing and poor irrigation. This can affect soil composition and can intensify or prolong periods of drought in places where the impact of climate change is already pronounced. This results in the loss of livelihoods and a decline in food security among agrarian communities living in semi-arid regions. To minimize the impact of future climate change, developing countries need to increase their adaptive capacity (Adger, et al., 2003). Numerous communities living in arid and semi-arid regions have adopted short-term and long-term strategies in order to improve food security and livelihoods (Twomlow et al., 2008). Since rain-

fed agriculture is a vital component in subsistence farming and droughts are commonplace in semi-arid regions, cost effective adaptation requires minimal dependence on land-based activities (Dube et al., 2007). For example, the practice of diversifying rural livelihoods to non-farm income activities like tourism, casual labour and crafts has been practiced extensively across East Africa with the intention of increasing household wealth and acting as a buffer against unforeseen climate shocks (Campbell, 1999; Berhanu et al., 2007; Martin et al., 2016). Using case studies of adaptation strategies from regions that share similar practical experiences can facilitate more efficient solutions in a shorter time. The process of knowledge sharing is important to ensure the resilience of communities vulnerable to climate change increases. Knowledge sharing is defined as the exchange of ideas and experiences through networks of relationships (Harvey et al., 2009). Climate change has had a major impact on the African continent. Several local communities are finding it difficult to come to terms with the impacts of climate change. It is crucial for these communities to have access to and share information on appropriate adaptive practices that would help increase their resilience (Harvey et al., 2009)

In recent years, livelihood diversification as an adaptation strategy has gained momentum with the aspiration of improving rural livelihoods by reducing poverty and stimulating economic growth in Sub Saharan Africa (SSA) (Barrett et al., 2001; World Bank, 2004; Niehof, 2004). In light of this information, diversification then is a strategy to reduce livelihood vulnerability, and is defined by Ellis (2000) as: “the process by which rural households construct an increasingly diverse portfolio of activities and assets in order to survive and to improve their standard of living”. This can be done by decreasing risk and poverty, and increasing income, wealth and security, thereby enhancing overall living standards of communities (Yaro, 2006). Diversification is one of the most common adaptation responses to climate risks and the most common diversification strategies used are, asset portfolio diversification, skills and occupational training, occupational diversification, crop choices, production technologies, consumption choices and animal breeding (Agarwal and Perrin; 2008). Ellis (2000), categorizes livelihood diversification under two broad distinctions namely necessity and choice. Diversification by choice is a proactive decision to increase overall household well-being, whereas diversification by necessity is from a place of desperation, when existing livelihoods are no longer sustainable and rural communities need to look for alternative livelihood options (Ellis, 2000).

As established in this literature review, cultural perceptions determine how people experience and respond to extreme events, which consequently affects livelihoods in semi-arid regions. Building on this, this research explores the value and use of livestock as a means of livelihood to communal farmers. Additionally, understanding the challenges to keeping livestock for marginal communities and perceptions is integral to this study. Drawing on the growth in barriers to adaptation research (see Lorenzoni et al., 2007; Jones and Boyd, 2011; Biesbroek et al., 2013), literature on barriers to selling livestock was reviewed to lay the foundation for impediments to individuals' livestock management practices.

Chapter Three: Methodology

In the following chapter the study site will be outlined, and the methodology of the study will be presented. Furthermore, the data collection process and analysis and tools used for the study will be discussed.

3.1 Description of Study Area

Located in the southwest of Africa, covering the vast expanse of 900,000 km^2, Namibia shares its borders with Angola in the north, South Africa in the south, Botswana in the east and the Atlantic Ocean in the west (Odendaal, 2011; Barnes, et al. 2012). With a population of 2.1 million people, it is considered to be sparsely populated and most of the country is categorized as semi-arid, making it one of the driest countries in Africa (ibid.). Close to half of the population of Namibia is situated in the North Central parts of the country and in the Omusati region, the average number of people per household is approximately 5.9 (NSA, 2011). This extremely dry country situated between the Namib Desert that stretches along the west coast and the Kalahari Desert that borders Botswana in the east and South Africa in the south (Odendaal, 2011).

This study was conducted in the Omusati region of North-Central Namibia in three villages namely Okathitukeengombe, Oshihau and Omahanene, located in the Onesi Constituency in the Omusati Region, as indicated in Figure 2 below. The Omusati Region is one of the selected sites for the ASSAR project; thus, the three selected villages in this region were suitable for fieldwork. The Onesi Constituency (14˚41’ 16, 6” E 17 ˚ 34’ 14” S) is one of 12 electoral constituencies with a population of approximately 13,000 (NSA, 2011) on the Omusati Region of Namibia. Namibia is a unique country in numerous ways and the North-central regions of the country are no exception to this. Newsham and Thomas (2009) suggest that the Aawambo people of these regions did not face as much colonial oppression from the German and South African settlers as their counterparts in other parts of the country. In addition to this, four regions namely Ohangwena, Omusati, Oshana and Oshikoto emerged as a part of the post-independence regions in the Aawambo basin, which over the past 70 million years has become a flat landscape because of the continuous deposition of sediments by water and wind cycles from higher areas in the vicinity (ibid)

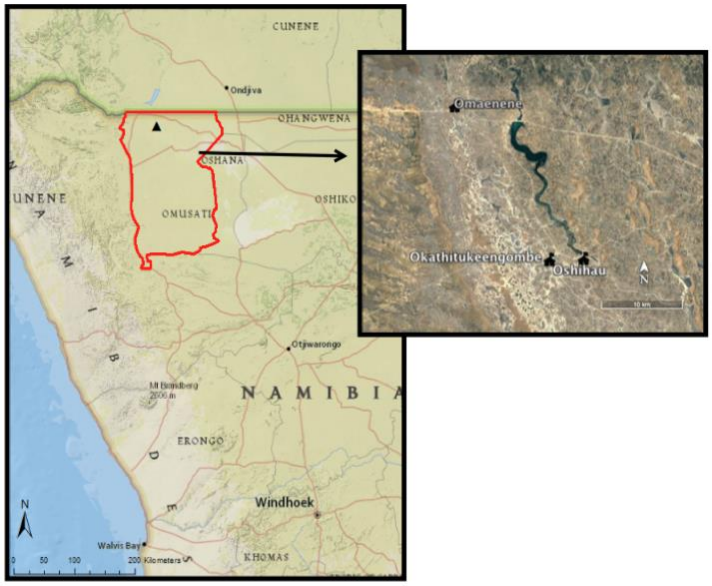

Figure 2: Location of three villages in the Onesi Constituency, Omusati Region, North-Central Namibia. Source: Chappel, 2016 using Arc, GIS.

The climate of Namibia can best be described as semi-arid to hyper-arid; with the mean annual rainfall ranging from 50 millimetres in the west and southwest parts of the country to 700 millimetres in northeast (MET, 2011) (Figure 3). The history of North-Central Namibia has been characterized by series of droughts and flooding (Mendelsohn, et al., 2000). One of the main components of the hydrological cycle is rainfall, a predominant water source for vegetation, agricultural activities and livestock production (Wang and D'Odorico, 2008). As in most parts of Sub Saharan Africa where 95% of cropland is rain fed (Rockström et al., 2010), the Omusati region is no exception to this rule. There are three predominant climate belts that Namibia's climate comprises, namely: the temperate zone, the intertropical convergence zone and the subtropical high-pressure zone. The intertropical convergence zone brings summer rain to the north and the east regions of the country and the subtropical high-pressure zone is responsible for the dry winter weather (Mendelsohn et al., 2002). Namibia experiences localized showers and thunderstorms during the summer months from November to April; which is the time it receives the bulk of its rain. However, temperature is usually higher during summer months and this leads to high evaporation rates (Mendelsohn et al., 2002) and a loss of water which is a limited resource in the country (Ondendaal, 2011). The vegetation is immensely distressed by the climate in the region and ranges from true desert to arid semi-arid desert and semi-arid savannah in the west and semi-arid and sub-humid woodlands in the north

(Barnes, et al. 2012). Furthermore, the Intergovernmental Panel on Climate Change (IPCC) has reported a further decrease in austral summer rain in southern Africa from Namibia, through Angola and further on towards Congo (Barros, 2014), which could result in fewer rainy days.

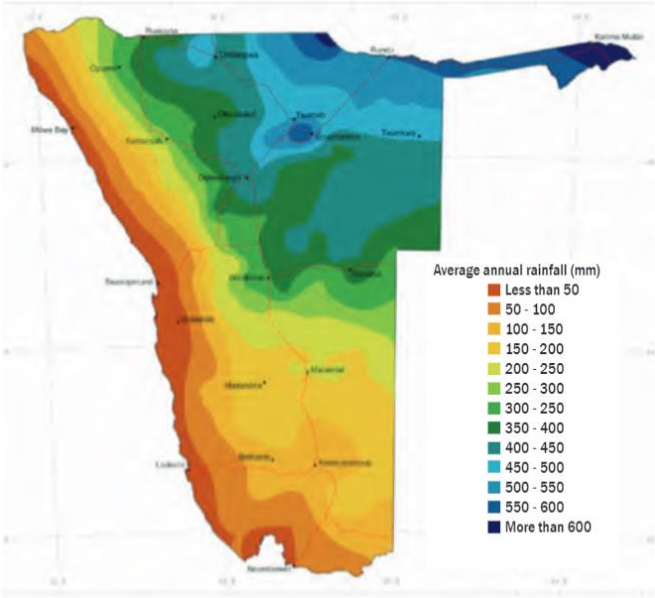

Figure 3: Distribution of average annual total rainfall in Namibia. Source: Mendelsohn et al., 2002

The Omusati region is characterized by land-use systems that combine livestock rearing, small-scale crop production and timber and non-timber resources (Marsh and Seely, 1992). A majority of the population living in rural areas are subsistence crop and livestock farmers (Angula and Kaundjua, 2016). Pearl millet or *'mahangu'* is a rain-fed crop that is predominantly grown in the Omusati Region of North-Central Namibia. In addition, to this, communal farmers grow maize and sorghum in smaller quantities (Mendelsohn et al., 2006). Apart from these cereals, communal farmers grow vegetables, nuts and legumes namely: beans, cowpeas, Bambara nuts, groundnuts, pumpkins and melons. Spinach, cabbage and tomatoes are not as commonly found, but are nonetheless grown in the region (Newsham and Thomas, 2009). The main livestock preference in this region is the Sanga variety of cattle followed by donkeys and goats (Mendelsohn et al., 2000; Newsham and Thomas, 2009) Although, literature suggests that the number of cattle have dwindled over the years, livestock farmers continue to hold on to their cattle mainly because they are synonymous of monetary wealth. Williams (1994) suggests that historically cattle have been used for breeding, sacrifice, weddings, paying off debt and for bartering with other goods (Williams, 1994). In addition to this, cattle are also used as reserve cash, to obtain goods and to pay for other miscellaneous services (Newsham and Thomas, 2009).

3.2 Research methods

The study conducted was based on a qualitative approach in which data was gathered using semi-structured household interviews in addition to a literature review that was conducted before commencing fieldwork. Gill et al (2008) suggest that household interviews are an effective way to help interviewers explore the research question. The flexibility of such interviews allows room for exploring certain aspects of the interview in depth which might not have previously occurred to the researcher (Gill et al., 2008). The interviews aimed to gain a deeper understanding of communal livestock issues by exploring different participant opinions and livestock management strategies? (Woodsong et al., 2011). The research was conducted in three villages namely; Okathitukeengombe, Oshihau and Omahanene, in the Onesi constituency, Omusati Region of North-Central Namibia from 4 – 15 July 2017.

A review of previous literature helps to lay the groundwork for advancing knowledge in the field of climate change adaptation (Webster and Watson, 2002). An initial literature review was conducted to understand the importance of livestock to communal farmers in the Omusati Region, as well as a summary of literature on local perceptions, challenges to keeping livestock in the face of climate change and the barriers to selling livestock, has been presented in Chapter two. The principal sources of this information include published literature in textbooks; both printed and electronic journals; and reports of relevant organizations.

In order to locate literature on alternate livelihood diversification strategies adopted in other semi-arid regions a systematic literature review was conducted using the Web of Science and presented as a table in Chapter six. Using ‘advanced search’ settings and the Boolean operator ‘OR’ between phrases in order to find relevant literature, the following phrases were searched: “non-farm”; “off farm”; “livelihood diversification”; “income diversification”; “semi-arid”; “drought”; and “rural households”. Additionally, the aforementioned phrases were searched separately using the ‘AND’ Boolean operation combined with the following nine semi-arid countries: Botswana, Burkina Faso, Ethiopia, Ghana, India, Kenya, Mali, Niger and Uganda. These countries were selected as most of them are ASSAR study sites and comprise arid and semi-arid regions comparable to Namibia. Relevant articles were considered in order to identify relevant diversification strategies used in each country and evidence of their success was identified and tabulated.

3.2.1 Cost Benefit Analysis

In order to assess the economic viability of selling livestock through formal marketing channels such as MeatCo in the Omusati Region, a Cost Benefit Analysis (CBA) using a simple benefit - cost ratio method was conducted. In this study, a CBA can help understand why or how communal farmers make certain choices about livestock sales (or a lack thereof) during a drought. It is important to note that only a CBA for cattle sales was conducted as the respondents could not recall all tangible costs for the upkeep of their goats and donkeys. According to Hanley and Barbier (2009) and Boardman et al (2014), a CBA is a technique that attempts to quantify in monetary terms whether the benefits of a plan outweigh the costs of a plan when implemented by a community as a whole. Additionally, if the benefits are positive or in other words outweigh the cost, then the plan implemented will make a community better off as a whole and should be implemented (Hanley and Barbier, 2009; Boardman et al., 2014). While this may be true in some cases, there are also non-market factors that influence livestock marketing that might be worth considering in a CBA. However, due to lack of information, these non-market factors were not considered while conducting the CBA. While performing a CBA in this study, the total benefits of selling cattle and the total costs of cattle upkeep by communal farmers were calculated in the year that household interviews were conducted. The total benefit derived from livestock was measured by the number of animals sold per annum (for 2017; the year the interviews were conducted) by communal farmers in the area; none of the respondents mentioned the average price of meat or milk derived from selling, hence the researcher omitted it from the CBA.

3.2.2 Semi Structured Interview Design

The aim of the semi-structured interviews was to collect data on livestock distribution and importance among communal households (Objective 1), to understand the perception of communal livestock farmers regarding past and future droughts with respect to the sale of livestock and to also gauge the economic viability through a CBA of selling livestock during a drought (Objective 2) and lastly, to analyse the barriers to selling livestock and consider alternative livelihood options so as to improve the lives of communal farmers in the Omusati Region (Objective 3). A set of questions were developed for the semi-structured household interviews to obtain information for the aforementioned objectives. Part I of the interview addressed the quantity and general purpose of livestock to the Aawambo people (Appendix 1).

Part II of the interview (Appendix 1) helped understand communal farmers' perception of past droughts and also future droughts in the region. It also opened a discussion between the researcher and the members of the household regarding the viability of holding on to livestock given the current climate situation in north-central Namibia. Part III of the interview facilitated a conversation between communal livestock farmers and the researcher (Appendix 1). The purpose of Part III of the interview was to open up a discussion that helped identify different barriers to selling livestock. This particular section of the semi-structured interview allowed communal farmers and family members to explore their perceptions by delving into reasons for not selling livestock in the face of climate change.

3.8 Data Collection

The research was conducted alongside a fellow researcher from University of Cape Town (UCT), who was conducting a study on farming practices in the Omusati Region. Upon arrival at the Onesi Constituency, researchers were first introduced to Secretary to the Uukolonkadhi Traditional Authority Mr/Tate Malakiya who took them to the first village – Okathitukeengombe. At Okathitukeengombe, researchers were introduced to village headman Tate Johannes. After briefing him about the consent forms and the research questions, the researchers along with their respective translators were permitted to interview 10 communal (crop or livestock) farmers in the vicinity. Since houses in Aawambo villages are remote with no motorable roads, some livestock farmers were selected and interviewed with the assistance of headman Tate Johannes, while others were selected through snowball sampling. There was a total of 35 livestock farmers in the village and of those only 10 farmers owned any livestock at the time of the interviews. 20 farmers said that they did not have any livestock after the drought and 5 farmers chose not to talk about this. Finally, 30 farmers who practiced livestock farming were interviewed.

The procedure in the next two villages was similar to the first. Researchers were introduced to headman Tate David of Oshihau and headman Tate Paul of Omahanene. Each of these headmen granted the researchers permission to conduct their respective 10 interviews with communal (livestock or crop) farmers after reviewing the purpose of the research, the consent forms and the semi-structured household interviews, which were translated to Aawambo by the translators before the fieldwork commenced. All the interviews were conducted in Aawambo with the help of the translator. The approximate time for each interview with was between 30-60 minutes on average, however, the duration of the interview was solely

dependent on the livestock farmers and how much information they divulged. If there were households that both researchers could interview, to avoid lethargy among the household members the interviews were split among them; male members usually answered livestock questions while female members answered questions pertinent to crop farming.

During the interviews, some farmers grew impatient from waiting for the translator to relay the information to the researcher. In order to resolve the matter, interviews were split in three parts with short breaks between each part. In Oshihau, households were selected with the assistance of the headman's secretary Ntandwe. When he was not available, the researcher resorted to using snowball sampling by walking around and asking the nearest household if there was a livestock farmer in the vicinity and interviewed them. In Omahanene, headman Tate Paul spoke to households with livestock set up the interviews on specific days and at specific times and this information was relayed to the researcher a day prior to the interviews. This method was efficient for both the household members and the researcher and allowed for interviews to be carried out in a timely fashion.

Participants in all three villages were receptive but had different approaches to the interview questions. Participants in Okathitukeengombe were very traditional and in some cases did not feel comfortable answering questions about livestock. In Oshihau, participants used modern tools and amenities in their homestead. They were keen to participate in the research but often expected rewards in terms of food, clothes, shoes and money for their time. Unlike the first two villages, Omahanene comprised Ondongo people. The researcher was informed that Ondongo's came from Angola and settled in the northern part of Namibia. They spoke a dialect of Aawambo called Ndongo which extremely similar to Aawambo barring a few words. Although the interviews in Omahanene were highly informative, the translator had minor language challenges, which were resolved with the help of headman Tate David who was fluent in English and hence was able to bridge this language barrier. The study did not divide the participants by gender, but by age so as to understand how perception over generations of communal livestock farmers regarding livestock implicated their decision to sell to keep their animals.

A Dictaphone was used to record the interviews. Additionally, the researcher took notes and recorded the interview on paper. This information was then transcribed and archived for data analysis.

3.9 Data Analysis

The recorded audio files were uploaded to a computer from the Dictaphone. Interviews were then listened to several times by the translator and the researcher to ensure the interviews were transcribed efficiently and that no data was lost in the transcription process. After the interviews were transcribed and translated into English, the raw data was imported into Microsoft Excel. The data was then coded into categories and themes pertinent to the Part I, Part II and Part III of the interviews. Information from Part I of the interviews was used to assess the importance of livestock by using the data to sketch out profiles of the respondents, household livestock distribution and their significance. This part of the interview was vital to understanding roles among family members and livestock distribution. Data from Part II of the interview was used for a cost benefit analysis to determine the economic viability of selling livestock for communal farmers in three villages. After having analysed the data, it was noted that valuing livestock as a contributor to household incomes was not a straightforward process. In his study on cost and benefits of livestock systems, Moll (2005) accounts for both tangible and non-tangible resources, however in this study the researcher only accounts for tangible resources. Non-tangible resources like social benefits and security against calamities were not accounted for due to lack of information from respondents. The total cost of upkeep of livestock is a combination of water plus feed plus dipping and vaccinations plus cattle post fee plus transport as mentioned by respondents. The aforementioned costs and benefits were used in the benefit-cost ratio (BCR) formula:

BCR = Total Benefits/ Total costs of upkeep

Two scenarios were considered by the researcher namely, Scenario I – benefits from sales in informal markets (based on sales reported by respondents) and Scenario II – benefits from selling in formal markets (as per the benchmark figures for 2017 of the Meat Corporation of Namibia (MeatCo)). Although prices on the website are slightly higher prices in rural areas north of the VCF, the researcher assumed the average weight per cow to be 200 kgs and the average price per kg as N$ 30 because prices for the animals are lower in rural areas given the condition of the animal (Shiimi et al., 2012; MeatCo, 2019). For Part III of the interview, it must be noted that the themes were developed based on the barriers to selling livestock. These themes emerged as interviews progressed and direct quotes from the respondents were recorded and placed into appropriate themes. The coded data allowed the researcher to analyse the

barriers to selling livestock by determining the volume of respondents saying the similar things. Quotations were used as illustrative examples in the discussion section of this study.

3.10 Approvals and Consent

After submitting the ethics clearance, the data collection was approved by the ethics committee in the Science Faculty at University of Cape Town (UCT). Consent forms were prepared (Appendix 2) and translated to Aawambo (Appendix 3) for the interviewer and respondents' signatures. In accordance with the ethics committee the consent forms were explained to the respondents and voluntary participation was required before commencing the interviews, which were recorded. Respondents were assured that their identities would not be revealed in the study, publicized or given to a third party.

3.11 Fieldwork Challenges

In person interviews are more informative as they provide the researcher with a plethora of valuable data on the subject and a deeper understanding of the subject matter on a personal level (Barbour, 2013). However, these interviews can feel extremely prolonged for the participants. If participants got tired, bored or distracted during the interview they could provide incomprehensible insight which could consequently affect the quality of information obtained from these interviews. In order to overcome this limitation, participants were informed about the structure of the interview and were given breaks in the middle if needed. Secondly, all the interviews were conducted in Aawambo which was translated by the translator to the researchers. However, if the respondent provided too much information or spoke faster than the translator could process the information and relay it to the researcher. Thus, researchers could be met with information loss during the interviews. This could happen if the respondent provided too much information or spoke faster than the translator could process the information and relay it to the researcher. This limitation was overcome by recording the interviews with a Dictaphone, listening to them intently and transcribing them right after the interview so as to avoid any loss of information that might be. In cases where the researcher was unsure of the information provided by the respondents, the respondents were asked to clarify the context of the information and relevance to the particular questions.

Chapter Four: The Importance of Livestock

In order to understand the importance of livestock in the lives of the Aawambo community, it is vital to look at livestock profiles of communal farmers across the three villages in this study. Furthermore, to understand the full extent of holding livestock in harsh climates, it is imperative to appreciate the benefits to communal farmers from livestock.

4.1 Respondent's profile and livestock distribution in Okathitukeengombe, Oshihau and Omahanene

A total of 30 households were interviewed comprising 41 respondents of which 25 were male and 16 were female. The mean age of the respondents was 52 years. Of this, 23 respondents were over 50 years and 18 under 50 years. Previous studies conducted in the Omusati Region reveal that livestock farming is predominantly carried out by older members of livestock farming households (Musaba, 2010; NSA, 2011). Likewise, while conducting household interviews, the researcher noticed that livestock farming activities and decisions were carried out by older members in the household. A report on Communal Sector Farming published by the National Statistic Agency indicated that the highest number of households practicing pasture management in northern Namibia (NSA, 2018). It is fairly common to see an Open Rotational Grazing (ORG) system in areas with uneven vegetation and erratic rainfall patterns (Rothauge, 2001). Additionally, ORG systems might be more productive than continuous grazing systems as they use a "vegetation readiness"[1] criterion which benefits both plants and animals alike (Rothauge, 2001). In this study, a majority of respondents described using continuous grazing patterns.

> *"My animals drink from the local dam. I do not buy food for them from Etunda, they just browse in local fields"*

However, during droughts, communal livestock farmers indicated that they practice transhumance. In the study, two farmers indicated that they mobilize their cattle during times of drought because of insufficient food and water.

[1] Readiness of plants is when plants are in their early maturity stage. During this stage the plant is photosynthesizing at a rapid rate and forming nutrients such as proteins, carbohydrates and minerals – all of which are required for gazing animals. This is an optimal time for grazing as plants are able to repair and revive parts that are consumed by the animal.

"I rent out fields for my animals during droughts."

"During the drought I send my animals to a cattle post where there is enough food and water for them."

The percentages of livestock kept by farmers are: cattle (83%), goats (93%) and donkeys (57%) (Figure 4). The proportion of communal farmers keeping goats outnumbered those keeping cattle. The Namibia Census of Agriculture's Communal Sector Report (2013-2014) also indicated that more farmers in communal areas kept goats as compared to cattle and donkeys (NSA, 2018). One possible reason for this could be that the Omusati Region has faced recurrent droughts which has resulted in disease outbreaks and cattle mortality in the past (Devereux et al., 1995; Sweet, 1998; Meissner et al., 2013). Furthermore, a study conducted by Koluman and Silanikove (2017), found that in comparison to other ruminants, goats have a higher capacity to transform feed to milk and meat and are hardier than cattle, especially during a drought (Sweet, 1998). Farmers in all their villages in this study supported the aforementioned finding and indicated that most cattle died of hunger during the drought in 2013.

"[I] lost 4 cows, my goats weren't really affected because they were able to find food, but my cows died of hunger."

For simplicity regarding gender results, only household heads were acknowledged as a representation of the number of males/ females holding livestock. In this study, household heads (either male or female) are considered as livestock owners. The reason for this is that head of the household manages finances and makes important decisions of which livestock ownership is paramount in the Aawambo culture (Tapscott, 1993; Mendelsohn et al., 2000). According to research by JS Malan, (as cited in Kaida et al., 2017) gender roles in the Aawambo culture are based on the division of labour, where women are responsible for crop farming and household activities, while men are responsible for livestock farming. In this study, gender results reveal that the proportion of males keeping any kind of livestock surpass the number of females keeping livestock, which aligns with the literature. Additionally, female headed households owned more goats (91%), when compared to cattle (73%) and donkeys (64%). A possible reason for this is found in the results of a study conducted by Togarepi, Benisiu and Namutenya (2018), in Ogongo Constituency, that suggests that goats are predominantly sold by female headed households and pensioners. Since these households rely on government

grants and remittances, they tend to supplement their incomes by selling goats (Togarepi et al., 2018).

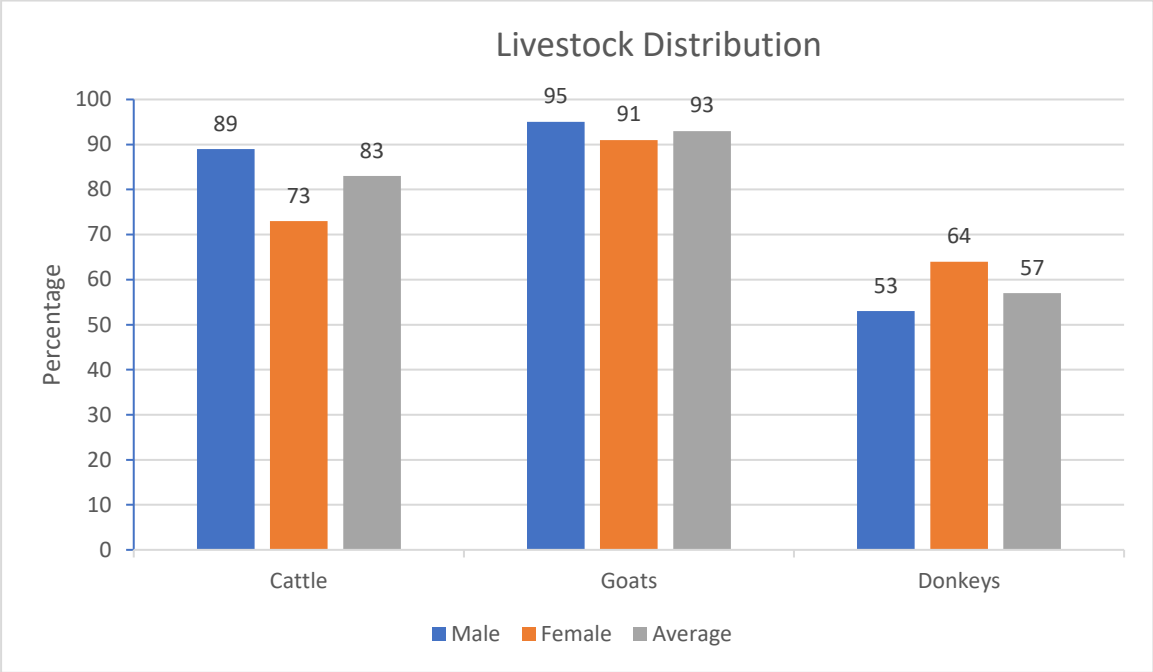

Figure 4: Percentage of male livestock, female livestock and total livestock distribution in Okathitukeengombe, Oshihau and Omahanene villages in Onesi Constituency, Omusati Region.

4.2 The significance of livestock to communal farmers in the Omusati Region

Farmers explained that cattle and goats were used mainly for meat, milk and breeding and donkeys for draught power and transportation (Figure 5). The use of livestock for milk, meat and breeding corresponds to the literature related to the importance of livestock to farmers in the Omusati region (May et al., 1995; Cousins, 1999; Musaba, 2010). The results from this study revealed that donkeys were not used for draught power uniformly across all three villages. In fact, communal livestock farmers that participated in the interviews in Omahanene stated that they did not use donkeys as draught animals as it was not part of their culture.

> *"Even though we live in Namibia now, we are Ondongo from Angola and in my culture only cattle and goats are preferred [not donkeys]."*

However, this was not the case in the other two villages and communal farmers in Okathitukeengombe and Oshihau indicated that they use donkeys as draught power in their *'mahangu'* fields and for transportation of goods.

> *"We do not use livestock to plough our fields. On one side we use tractors and on the other side we use donkeys to plough our fields."*

> *"I use donkeys to collect water and plough "mahangu"."*

> *"During ploughing season, I take my donkeys to plough some fields and get a little income from there."*

Results from this study reveal that communal livestock farmers in the Omusati region predominantly owned older livestock; cattle between 3-10 years and goats between 3-10 years, where a higher percentage of goats (64%) as opposed to cows (48%) were used for meat. It is important to note that only male cows are used for meat and cows used for breeding and milk. It is common practice in the Aawambo culture to keep cattle as a precautionary measure for unforeseen emergencies like financial problems, natural calamities and funerals (Einzig, 1949; Tapson and Rose, 1984; Cunningham, 1997; Sweet, 1998; Musemwa et al., 2007; Togarepi et al., 2016). Given the aforementioned statement, it is justified that livestock farmers kept a higher percentage of goats for slaughtering than they did cattle.

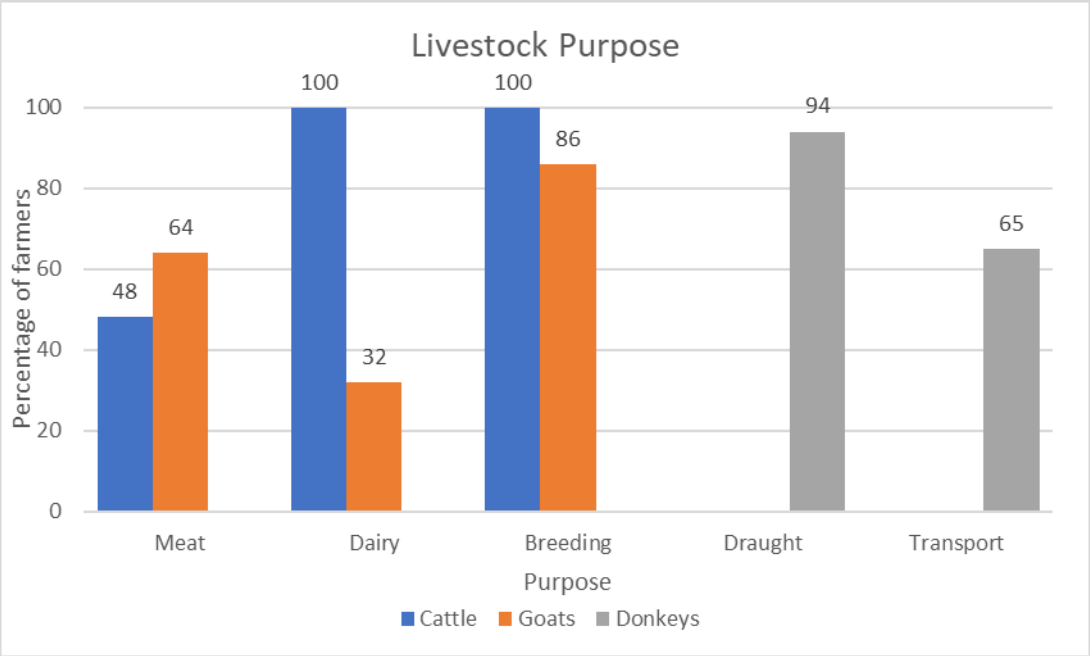

Figure 5: Percentage of total farmers using livestock for various purposes shown in Okathitukeengombe, Oshihau and Omahanene villages in Onesi Constituency, Omusati Region.

The respondents were asked about the significance of livestock as a source of livelihood. In response to this, only 17% of the respondents indicated that they are directly dependent on livestock. An older farmer who mentioned that livestock was his only source of livelihood indicated that he could not imagine a livelihood without livestock.

"Livestock is my source of everything and cattle is my first option"

The most common reason stated for keeping livestock was that it acted as a supplementary income and supported households where their income fell short. 83% of the respondents indicated that they are not directly dependent on livestock and they use their animals as a supplementary source of livelihood. In response to this, two respondents explained that though they did not directly depend on livestock, however, they did receive substantial benefits from them.

"When cattle give birth, I will get milk. When I slaughter, I will get meat which I can sell and get money".

"I grew up in a homestead of livestock and do they help me a lot."

Findings from a from a similar study by Musemwa et al., (2008) suggests that communal farmers in South Africa keep Nguni cattle for a myriad of socio-economic reason and depend on cattle for subsistence – milk, meat, hide and horns. Additionally, they use their cattle for unforeseen financial crises like medical emergencies, school fees taxes and household expenses (Musemwa et al., 2008; Shackleton et al., 1999).

Having established the significance of livestock to communal farmers, respondents were asked what they would do if they did not have livestock to supplement their incomes. Three respondents were visibly perturbed by this question and were averse to entertaining a reality where livestock were not part of their livelihoods.

> *"In my culture there is a saying that says: where there was something those things never finish and so there will be some remaining livestock to support me financially for my family".*

There was a sense that the respondents who used livestock as their primary source of livelihood, could not fathom a scenario wherein livestock would be completely obliterated from the lives of communal farmers in the Omusati Region, whereas those farmers who used livestock as a supplementary source of income were not affected if livestock was obliterated from their lives.

> *"I have a restaurant. That is my main source of income and it supports my family."*

> *"I am a businessman. I do business and I'm a farmer…I'm selling export goods. I'm also a contractor. I'm building and I'm selling".*

In the case of older members of the Omusati region, the Government of Namibia (2010) recognizes the need to offer financial support to citizens over 59 years or to persons who have been deemed physically disabled by a state physician. Among the respondents who did not use livestock as a primary source of livelihood, 50% of these respondents admitted that their main source of income was their pension.

> *"I get a pension from the government and I get veteran money since I was also part of the Namibian Liberation Struggle. I used to be a school teacher".*

> *"I used to work in Walvis Bay in fishing and now I receive a pension".*

Another 7% of respondents said they received compensation from the government disability fund. Two respondents indicated that government support was integral to their family's livelihood.

> *"Our dad is disabled from the Liberation Struggle so [he] receives a government grant."*

4.3 The Role of Livestock in Communal Farming in Onesi

When reflecting on the role of livestock and communal farming in Onesi, it is evident that based on gender roles, livestock farming is predominantly carried out by older male members in the households, while female members tend to agriculture and household chores. In this study, farmers suggest that cattle are not a primary source of livelihood among communal farmers in the Omusati Region. Additionally, the most common reason for holding livestock among communal livestock farmers in the region is to support existing incomes and to alleviate rural households from poverty, unforeseen emergencies and for social occasions.

Some respondents believe that their lives are incomplete without livestock and cannot imagine a reality where they do not own livestock. Other respondents are not concerned about the future as they believe that their existing livelihood sources and the government support will help them, however they will continue to try and procure livestock till they die. Given that livestock numbers have been dwindling because of the drought, yet farmers need to hold onto their animals deserves a deeper understanding of farmers' perspectives in order to improve the lives of communal farmers in semi-arid regions. This kind of understanding can help shape adaptation strategies so that communal farmers are better equipped against the effects of climate change. Farmer perceptions about droughts and the viability of holding livestock, in the following chapter, are based on farmer experiences and traditional values. This is not to say that this kind of information should hamper future policy design but rather be integrated with scientific knowledge for better adaptation pathways.

Chapter Five: Perceptions of Drought Among Communal Farmers

The following chapter focuses on the perception of communal livestock farmers regarding current and future droughts with respect to the sale of livestock. It asks whether communal farmers perceive themselves to be vulnerable to climate change and whether it is viable to keep livestock.

5.1 The Impact of droughts on livestock

In response to questions about the recent drought and how it might have affected livestock numbers, 24 farmers (out of 30) indicated that their cattle numbers had significantly dropped after the drought that hit northern Namibia in 2013. 11 respondents indicated that they lost goats during this time and another 5 respondents said that they lost donkeys. Respondents that suggested greater cattle losses than goats stated that unlike their cattle, their goats were able to endure harsh drought conditions. A communal farmer confirmed this, *"My goats were not affected by the drought…but my cattle died of hunger".* This aligns with a study conducted by Seo and Mendelsohn (2007), that established that the probability of choosing goats over cattle is much higher among livestock farmers when there is a significant rise in temperature; a possible reason for this could be because of cattle mortality rates.

The most common mentioned reason by farmers for animal losses was a lack of food (53%) followed by lack of water (10%) (Table 1). This information is valuable because local perceptions about changes in livestock numbers dictate whether or not people will change their behaviour. These perceptions about livestock loss due to decreased food and water supplies align with the literature related to the challenges to keeping livestock (DWA, 1991; Devereux et al., 1995; Sweet, 1998; Seely et al., 2006;). Additionally, lessons learnt from a study conducted by ASSAR in northern Namibia revealed similar effects of drought in the region (Ziervogel, 2016). Ziervogel (2016), writes that during months of drought, water sources are highly stressed and food production reduced considerably. This in turn affects livestock health and mortality rates.

Two respondents stated that their goats did not die, but went blind – however, the reason for this was vague (Table 1). Hartmann (2019), mentions in a report on animal health in Namibia that a common reason for blindness in livestock is due to lead poisoning. He states that it is not uncommon for goats to gain access to old car batteries and lead tins while grazing

in communal rangelands and this often damages their nervous system. Hence, blindness in goats in this study area might be associated with lead poisoning.

Furthermore, a farmer mentioned that his goats were not affected by the drought, however his animals died from being poisoned (Table 1). This phenomenon of livestock poisoning by plants is a consequence of overgrazing and poor range management, and that the number of unpalatable species (poisonous plants) increases with higher grazing intensities (Holechek, 2002). Naude, Kellerman and Coetzer (1996) concur that 10-25% of stock losses in southern Africa are caused by ingesting poisonous plants. Hence, the loss of goats due to poisoning in this study could be a consequence of over grazing and poor range management.

Table 1: Reasons farmers mentioned for observed loss in livestock

Theme	**Number of Respondents**	**Illustrative quote**
Lack of food	16	*"The drought affected our livestock so bad in 2013 because there was not enough food."*
Lack of water	3	*"The drought hit me hard. I can say both water and food was not enough."*
Blindness	2	*"My goats got blind"*
Poisonous Plants	1	*"My goats were not affected by the drought they died because they ate a poisonous plant in the wild."*

5.2 Perceptions about future droughts and livestock keeping

In order to ascertain perception about future changes in the local climate of the region, respondents were asked specifically whether they thought the droughts would be worse in the future. The most popular response was 'unsure if droughts wil1 improve or worsen' (36%) followed by the sentiment that 'droughts will worsen' (33%) (Table 2). Other respondents (16%) said that they 'did not know what would happen', followed by the opinion that, 'it was up to God' (13%) (Table 2). Christian faith is prevalent among people in northern Namibia and due to this, farmers have accepted their fate and firmly believe that rainfall is dependent on

God's will (Davies et el., 2018). Some farmers also recalled the change in their environment over the last couple of years and mentioned that it was getting drier and their animals were suffering because of the intense heat.

Table 2: Perception about future droughts (n=30)

Theme	**Number of Respondents**	**Illustrative Quotes**
Unsure if drought will improve or worsen	11	*"Do not know…I really can't tell what is ahead of me"* *"The drought might come back and if there is not enough rain it might be worse and if we receive enough rain, the drought might even become better."*
Drought will worsen	10	*"According to indigenous knowledge we can predict…the drought will worse"* *"The drought is already here, and I can predict this one is going to be worse because I was travelling from Outapi to Onesi and the sand was clear and there were no plants"*
Drought will improve	5	*"Maybe the drought will be better in the future because it seems like there is enough food"*
It depends on God	4	*"We are just waiting to see what type of drought God is going to bring"* *"It is God's work"* *"I really do not know what is ahead of me only God knows."*

Although a majority of respondents perceived that the drought will either worsen or were unsure about the occurrence of future droughts, nearly all (80%) respondents said that they would continue to keep livestock in the future, while others were not certain about what to do and indicated that they might sell their livestock if they continued to die (20%). When

the respondents were asked why they thought it was integral to hold on to livestock in the face of drought, a few respondents reasoned that holding livestock (especially cattle) was very important to the Aawambo community, as illustrated in the quotes by two respondents.

> *"It is a part of our culture; we will buy more when we have a job. We cannot stay without cattle; they solve a lot of our problems."*

> *"In my culture there is a saying: where there was something those things never finishes so they would be some remaining livestock to support me financially from my family."*

Among the 24 respondents who said they would hold onto their livestock in the future, another respondent said that his livestock was a means of financial security.

> *"We are Aawambo people, we fear to be poor. Money is always a temptation. No matter if you sell your cattle for R50000, at the end of the day you'll find yourself left with R10000 and at time with only R3000-R4000 and so we do not trust money [and trust our livestock]".*

However, among 30 respondents, six respondents said that they would not hold their livestock if droughts got severe in the future.

> *"As we know, [the] drought can also affect people. So, I'm not going to let people die and just save the animals, so I'll save the people by selling the animals".*

Farmers across all three villages believe that the climate is changing from past experiences of the drought. Given this knowledge and the deterioration in animal health that the changing climate has brought with it, it would be natural for farmers in the region to sell their animals rather than hold onto them. However, a majority of farmers were unwilling to change their practices. This behaviour indicates that although people's perceptions align with the local changing climate, the impact of these changes is not affecting their decision-making process. Additionally, a misinterpretation of these changes can lead to maladaptation (Becken et al., 2013).

5.3 The viability of keeping livestock – A cost benefit analysis

Having analysed the impact and perceptions of future droughts, the total benefit of selling livestock (from an economic standpoint) can be expressed using two scenarios namely, Scenario 1: the benefit of holding livestock and selling in informal markets as and when the needs arise; and Scenario 2: the benefit derived from selling animals to MeatCo at the end of the year as seen in Table 3. In terms of numbers of livestock for sale, only male cows were considered in the study; cows are usually kept for breeding and are not sold. Therefore, in instances where there are no sales of cows, but there are costs for maintaining livestock– these costs may be attributed to cows.

Results from the CBA (Table 3) revealed that the benefit derived from keeping livestock in terms of economic viability in Scenario 1 is not ideal for communal farmers across all three villages as the cost of livestock upkeep surpasses the benefits; barring three cases. Although non-tangible benefits were not covered in the CBA, the interviews suggested that the only benefit derived from holding cattle is insurance and social status. For instance, when asked about selling his cattle, a farmer in Oshihau said, *"I cannot sell now because livestock are my backup bank. When I have to pay for my kids' education or some problems like debt"*; another farmer in Omahanene mentioned *"Whenever we need money, we use our livestock"*. Furthermore, with respect to social status, one respondent said, *"as per our culture livestock are a source of wealth and status and we fully believe that"*; another respondent said, *"I believe that livestock is a part of our culture and by owning them, I am definitely better off than someone who doesn't have them"*.

Results from the CBA (Table 3) in Scenario 2 reveal a positive benefit cost ratio which means that the benefits from selling cattle to MeatCo in all relevant cases outweigh the costs of upkeep for communal farmers in the region. Having analysed Scenario 1 and Scenario 2, based on the numbers of the benefit cost ratio it is clear that communal farmers stand to gain a substantial benefit from selling cattle through formal marketing channels. However, selling through formal marketing channels is not a straightforward process for a myriad of barriers (discussed in Chapter six) including formal markets and institutions. As established above, the primary purpose of holding cattle stems from Namibian traditional values surrounding cattle and not for agricultural enterprise (Nkosi and Kirsten, 1993). During an interview one farmer mentioned, *"We do not have a quota or an auction, we just sell when we need to*". This is in agreement with the finding of Togarepi et al (2016) in Ohangwena Region of north-central

Namibia who found that the majority (78%) keep cattle for traditional purposes like weddings, paying debts and funerals, consumption (16%) and income purposes (4%).

Moll (2012) supports the finding from the CBA (Table 3) and suggests that livestock are often used as financial aid and as a measure of status in communities in the Western Province of Zambia that lack the means to fulfil these functions. It is the lack of financial institutions and proper marketing channels in rural areas that compel communities to turn to alternative avenues that are at their disposal in order to cope with the unanticipated happenings of life (Moll, 2012). Very few respondents in the interviews mentioned selling cow meat for *mahangu* and money. Those that did, did not quantify the amount received, hence it was omitted from the CBA. Intriguingly, none of the respondents in the interviews mentioned benefiting from milk sales. A possible reason for this could be that the dairy industry is not as well developed as the meat industry in Namibia (Marius, 2017). Marius et al. (2012), additionally mention that cattle are able to produce the bulk of their milk during the wet season which usually lasts from January to June in Namibia, after which there is a decline in milk production during the long dry season due to lack of feed and the inability to produce milk by female cattle.

Table 3: Cost Benefit Analysis (n=30)

HH No	**No of cows**	**Total Cost of Upkeep (incl Water, Feed, Dipping, Vaccinations & Others) (R)**	**Total Benefit**		**Benefit Cost Ratio**	
			Scenario 1	**Scenario 2**	**Scenario 1**	**Scenario 2**
1	11	3985	17800	66000	4.5	16.5
2	15	5000	0	90000	0	18
3	3	5780	0	18000	0	3.1
4	4	24000	0	24000	0	1
5	1	300	0	6000	0	20

6	1	7500	0	6000	0	0.8
7	2	800	0	12000	0	15
8	0	0	0	0	0	0
9	20	15700	0	120000	0	7.6
10	0	0	0	0	0	0
11	2	2880	0	12000	0	4.2
12	4	5900	0	24000	0	4
13	0	3049	0	0	0	0
14	2	0	0	12000	0	N/A
15	2	12000	0	12000	0	1
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	2790	6500	0	2.2	0
19	2	3750	0	12000	0	3.2
20	25	35400	12000	180000	0.3	5.0
21	8	8000	0	48000	0	9.6
22	13	4500	0	78000	0	17.3
23	2	0	0	12000	0	N/A
24	6	8600	0	36000	0	4.2
25	240	86000	290000	1440000	3.3	16.7
26	2	12000	0	12000	0	1

27	3	5180	0	18000	0	5.6
28	3	3850	500	8000	0	4.6
29	5	5228	0	30000	0	5.7
30	18	8150	0	108000	0	13.2

5.4 Perceptions of current and future droughts and the viability of holding livestock

When reflecting on the perceptions of current and future drought the results indicate that communal livestock farmers in the Omusati region perceive that they have experienced a decline in rainfall in the region and an increase in temperature. Furthermore, they have witnessed the deteriorating health and mortality rates of their livestock as a consequence of climate change in the region. They also invest immense amounts of monetary resources in the upkeep of their animals and do not necessarily benefit from sales, which in turn, is a drain on wealth. Additionally, this part of the study concluded that the main purpose of keeping livestock is not driven by production to sell in markets, but as a method of risk aversion and social status which significantly hinders selling of livestock; communal farmers essentially do not recognize the economic benefit they might get from selling their cattle. This exposes communal farmers to economic vulnerabilities from not selling livestock while investing economic resources in their upkeep. Additionally, this vulnerability will increase as the challenges of keeping livestock (discussed in Chapter 2) will be further exacerbated by hotter days in the future Thus, the impacts of climate change identified in this chapter are directly connected with farmers' livelihoods.

Though this information calls for adaptation strategies such as livelihood diversification, there is no 'quick fix' remedy that can be applied to this particular situation. Therefore, in order to fully understand the extent of the problem, local perceptions and attitudes regarding the sale of livestock have to be considered. According to Adger et al., (2009) future climate decisions are moulded by the knowledge of past, present and anticipatory future climate experiences. However, in the current study, it appears that the majority of respondents could not gauge the outcome of droughts in the future by themselves and were unwilling to alter their

livestock farming practices. This reinforces the notion discussed by Becken et al. (2013), that people's perception is not always an accurate measure of climate change and misinterpretation of these changes could lead to maladaptation. Barriers to selling livestock stem from traditional values and will be discussed in the following chapter so as to help understand the link between climate change and effective adaptation practices.

Chapter Six: Barriers to the Sale of Livestock

The following chapter focused on analysing the barriers to selling livestock so as to improve the lives of communal farmers in the Omusati Region. This includes identifying the barriers to selling livestock, assessing alternative livelihood diversifying strategies adopted by communal farmers in semi-arid regions and the willingness of communal farmers in Onesi to adopt new strategies.

6.1 Barriers to selling livestock

Respondents were asked what they believe is inhibiting them from selling their livestock given the numerous challenges of keeping livestock (discussed in Chapter five). The barriers to selling livestock can be broadly grouped as culture, economic, information and institutional (Table 4). It should be noted that the aforementioned barriers are used for the purpose of the study to group barriers; in reality, several barriers interact at varying degrees with one another to shape farmers' decisions.

Local cultural beliefs about holding livestock were the greatest barrier identified among communal farmers (83%). Farmers professed that they would continue to relentlessly build their stock, especially cattle, whilst being fully aware that the drought might worsen. A male farmer understood that the drought might be detrimental to his animals but insisted on keeping livestock because of the cultural stigma attached to male members who did not own livestock in the Aawambo culture. This corresponds with the study conducted in northern Namibia by Togarepi et al. (2008), where culture was cited as a reason preventing farmers from selling their livestock. The primary reason for this is that owning livestock has been seen as a symbol of wealth and stature.

The next mentioned barrier was financial security (76%), which can be categorized as a cultural, institutional and an economic barrier. Respondents (76%) across all three villages mentioned that they faced income shortages during times of droughts and invariably resorted to holding livestock as a means of insurance when they needed liquid assets. Risk aversion by keeping livestock due to the cultural and insurance aspect is a common phenomenon in semi-arid regions that depend on rain-fed agriculture for their livelihood (Fafchamps et al., 1996). Additionally, a deficit of financial institutions (government aid, banks etc.) available to communal farmers compel them to keep their livestock as a buffer stock during unforeseen

income shocks. In light of this information, farmers in the Omusati Region have believed that keeping livestock is extremely vital to their financial security. Furthermore, they explained that holding livestock was a value passed down through generations of communal farmers in the region.

Respondents who cited lack of technical knowledge, skills and education and communication in this study, were broadly categorized under lack of access to information. Lack of access to information was a significant barrier to selling livestock among communal farmers (73%). They explained that they lacked technical knowledge and skills in order to explore alternative livelihood options. They expressed that livestock farming was passed down to them by their elders and it is the only way they know how to earn a living. Alternatively, farmers in the regions who did not mention lack of information as a barrier to selling, said that they would be interested in learning about the problems associated with keeping livestock during droughts. One respondent said, *"If we were educated, it would be easier because everyone does not understand livestock and people become victims of their own family members"*; therefore access to knowledge about livestock could be very useful to the communal farmers in the Omusati Region, especially since the drought has been predicted to worsen in the future. 'Lack of information' about things pertinent to livestock markets and veterinary facilities was identified as a barrier. Additionally, farmers mentioned that they were unwilling to sell their livestock because the information on the radio was both insufficient and unreliable.

With regard to institutional support, a majority of communal farmers (70%) believed that government institutions could do much more to support communal farmers with their livestock. One communal farmer stated that the government could help the community by providing access to water points and tractors to plough *mahangu* fields, while another suggested that institutions could help resource-poor farmers with vaccinations for their livestock. Older farmers across all three villages namely, Okathitukeengombe, Oshihau and Omahanene expressed that the government should increase existing pension values of $1000. There were no gender disparities regarding cultural beliefs and institutions.

Lack of markets to sell their stock was another barrier mentioned by farmers (36%) which is an economic and institutional barrier. Communal farmers in 11 households mentioned markets as a barrier to selling. One plausible reason for this could be that most households interviewed in this study did not start selling their livestock for reasons discussed in Chapter

five. Communal farmers who complained about the lack of formal and fair markets to sell their livestock explained that even if they want to sell their animals, limited buyers, high transaction costs and unfair prices would often deter them from selling their stock. Further, they believed that the formal markets were flawed and that they were being cheated by companies like MeatCo. Another barrier to selling associated with markets was access to markets. Farmers expressed that distances from their villages to formal markets were quite large and their animals would get sick on the way there from lack of food and water. A few farmers mentioned that their children were struggling to find jobs in cities and because the job market was down, they did not have an income and thus they needed to hold on to their livestock in order to procure cash for their family when needed.

Table 4: Barriers to selling livestock in the Omusati Region

Barriers	**Themes**	**Number of respondents**	**Illustrative quotations**
Social	Normative values shaped by culture	25	*"I believe that livestock is a part of our culture and by owning them, I am definitely better than someone who doesn't have them. If I sell my cows, I feel like I am cheating on my culture"* *"Culturally as a man you cannot stay without livestock"* *"I believe that cows help to bail me out of my problems, that's why I will continue to keep them"* *"As you can see, I have only 3 cows, if I sell all of them how am I going to be without any! Traditionally I do not want to sell my livestock because I have to breed them for my wife and kids who will remain even after I pass on."* *"The main reason we have animals is for family. If they need them for anything, we can use them. We are not farmers; we just have animals to have them"* *"My kids want to get married but we do not have enough cows. Us with a few cows are belittled in society"*
Economic, Institutional	Lack of financial security	23	*"Whenever we need money, we use our livestock"* *"We have them when we need to help ourselves, we do not like to sell. When you have goats and lose your jobs, they will help you and we help people in your community"*

			"They bail me out of poverty" *"I cannot sell now because livestock are my backup bank. When I have to pay for my kids' education or some problems such as debt.* *"I'm not into selling my livestock, but I see that others also hold on to them so I know that animals can help me in my time of need."* *"If I sell them, I will use up all the money at the end of the day"*
Information	Lack of information	22	*"The information I get from the media is not sufficient, and the news comes at specific times a day, but it is always changing and sometimes when I turn the radio on, I miss this information"* *"We hear some information on the radio, but it is not enough"* *"There are no experts here, like you, who come and tell us what is going on"* *"We do not have educational courses which can help us know more about livestock."* *"With my level of education, I understand livestock, but I do not have enough knowledge."*
Institutional	Lack of Institutional Support	21	*"We do not have enough water and have to pay for it. Maybe the government can build us a damn or give us a good price for our tractors to help us plough our Mahangu fields."* *"My pension is not a lot, if it was R3k-4k it would be better, but now it is only 1k and it is not a lot to sustain."* *"The government needs to increase our pension; we only get N$1000/month"*
Economic, Institutional	Lack of efficient Markets	11	*"The markets are slow and in addition to this, we are not close to any meat markets. Sometimes my cows are worth only N$600 and I can't do too much with such little money."* *"There are no market places around here – they are all very far away"*

It is evident from this study that selling livestock is constrained by the cultural values, a lack of financial security, lack of information, lack of institutional support and lack of efficient markets, which have also been researched in other parts of Africa. Local beliefs, particularly passiveness caused by cultural norms, which was the greatest barrier among communal farmers in the Omusati Region was also predominant in farmers' decision to hold on livestock in Tanzania. Quinian et al. (2016) found that in Tanzania, among Masai farmers, livestock are seen as assets and a symbol of well-being and selling these assets are historically and socially undesirable. These findings are comparable to those in South Africa and Kenya, where farmers believed that cattle are a symbol of wealth and socio-economic stature (Ouma et al., 2003; Musemwa et al., 2008;). It can be inferred that local beliefs and cultural values prevent livestock farmers from selling their livestock. Numerous studies conducted in Africa concur with the outcome in this study that economic barriers such as lack of financial security and lack of efficient markets deter communal farmers from selling their livestock (Nkosi and Kirsten, 1993; Shackleton, 1999; Mendelsohn et al., 2000; Bayer et al., 2003; Dovie et al., 2006; Kaakunga and Ndalikokule, 2006; Togarepi et al., 2016;). Lack of institutional support in terms of agricultural assistance and government grants is also an economic problem because communal farmers then have no option but to turn to their livestock as a means of financial security (Angula and Kaundjua, 2016). Marketing constraints for communal farmers in northern Namibia are an outcome of various facets. For example, livestock in this region (like most developing countries) was only sold during an emergency in order to obtain funds for unforeseen economic crises (Nkosi and Kristen, 1993), thus concluding that holding livestock is not market oriented and could be a plausible barrier to selling. Communal farmers mainly use informal (local butchers, fellow farmers and individuals) marketing channels to sell their livestock (De Bruyn et al., 2001). High transaction costs, unfair pricing, small herd sizes, restrictions imposed by the VCF (De Bruyn et al., 2001; Hangara et al., 2012; Togarepi et al., 2016,) makes it very tedious for farmers to sell in formal marketing channels (MeatCo). The findings from northern Namibia are compatible with a case study from Kenya. Onono et al. (2015) found that pastoralists in Kenya faced marketing constraints which included lack of meat markets and trekking of cattle. Household commodities like a radio to access information about livestock is essential while making selling decisions among communal farmers (Hangara et al., 2011). This corresponds to the finding among farmers in this study.

6.2 Alternate livelihood diversifying strategies adopted by farmers in other semi-arid regions

Populations in remote and arid regions have dealt with climate change in harsh and variable environments by relying on indigenous knowledge, livelihood diversification and strong social ties (Mertz et al., 2009). Given the evidence of sufficient resilience to climate change, people in these parts believe to be well equipped to deal with climate change in the future (Maru et al., 2014). Therefore, successful livelihood diversification strategies adopted in other semi-arid regions could provide a foundation for potential adaptation solutions in northern Namibia. Apart from having similar climates and climatic and non-climatic stressors, these countries have similar traditional values towards livestock where "the possession of cattle is inextricably interwoven with the acquisition of prestige" (Coertze, 1986). Cross-border adaptation practices could help improve local livelihoods, thereby enhancing resilience to climate change. Hence, a systematic literature review of livelihood diversification strategies used in six other semi-arid regions was conducted (Table 5).

Table 5: Diversification strategies adopted in other semi-arid regions

Diversification Strategy	**Description**	**Country and Reference**
Destocking livestock	Selling livestock to buy food during times of drought or moving them to alternative rangelands with better feed	Palapye, Central District of Botswana (Akinyemi, 2017) Aba'ala, Afar Region, Ethiopia (Berhe et al., 2017) Central highlands, Ethiopia (Alemayehu and Bewket, 2017) Turkana, Kenya (Opiyo et al., 2015) Borana pastoral area, southern Ethiopia (Berhanu and Beyene, 2015) Laikipia District, Kenya (Ogalleh et al., 2012)

		Rural districts, Kenya (Silvestri et al., 2012) Awash River Basin, Ethiopia (Murendo et al., 2011) Makueni District, Kenya (Ifejika Speranza and Chinwe, 2010) Central and south Mali (De Brujin and van Djik, 2003)
Off-farm incomes	Supplementing existing on-farm-incomes that are climate sensitive with non-farm incomes within the agriculture sector	Palapye, Central District of Botswana (Akinyemi, 2017) Turkana, Kenya (Enns and Bersaglio, 2016) Turkana, Kenya (Opiyo et al., 2015) Mali, (Favretto et al., 2014) Awash River Basin, Ethiopia (Murendo et al., 2011) Kenya, (Gachathi and Eriksen, 2011) Southern Ethiopia and northern Kenya (Berhanu et al.,2007) Northern Kenya and southern Ethiopia (Little et al., 2001) Eastern Himalayan region, India (Rahut et al., 2015)
Restocking livestock	Improving herds by acquiring drought resistant livestock	Aba'ala, Afar Region, Ethiopia (Berhe et al., 2017)

		Borana pastoral area, southern Ethiopia (Berhanu and Beyene, 2015) Rural districts, Kenya (Silvestri et al., 2012)
Cropping	Growing and harvesting crops during a wet season (consistent rainfall) with the intention of stocking up during times of future climate variability and food shortages	Aba'ala, Afar Region, Ethiopia (Berhe et al., 2017) Borana pastoral area, southern Ethiopia (Berhanu and Beyene, 2015)
Non-farm incomes	Pursuing alternative economic activities in order to generate supplementary incomes, sometimes with the assistance of public institutions and NGOs.	Bosomtwe District, Ghana (Yambat et al., 2017) Turkana, Kenya (Opiyo et al., 2015) Borana pastoral area, southern Ethiopia (Berhanu and Beyene, 2015) Awash River Basin, Ethiopia (Murendo et al., 2011) Mwingni, Kenya (Wren and Speranza, 2010) Laikipia, Kenya (Wren and Speranza, 2010) Kilifi, Kenya (Wren and Speranza, 2010) Southern Ethiopia and northern Kenya (Berhanu et al.,2007) Kenya (Eriksen et al., 2005) Northern Kenya and southern Ethiopia (Little et al., 2001)

Access to Credit	Having access to credit from private lenders and public institutions helps farmers obtain funding for alternative livelihood endeavours	Central highlands, Ethiopia (Alemayehu and Bewket, 2017) Mbitini Location, Kenya (Eriksen et al., 2005)
Changing consumption patterns	Reducing spending on meals, wedding and funerals by decreasing socialization	Central highlands, Ethiopia (Alemayehu and Bewket, 2017) Awash River Basin, Ethiopia (Murendo et al., 2011)
Mixed Farming	A farming system that includes livestock herding and cropping as a risk reduction strategy during climate variations	Rural districts, Kenya (Silvestri et al., 2012) Keiyo District, Kenya (Kariuki et al., 2007)
Diversifying livestock herd	Keeping a mix of livestock that enable farmers to distribute rick among animals and survive harsh and variable climates	Turkana, Kenya (Opiyo et al., 2015) Borana pastoral area, southern Ethiopia (Berhanu and Beyene, 2015) Dire and Yabelo district, Ethiopia (Megersa et al., 2014)

6.3 Willingness to adopt new strategies in Onesi

When asked about the willingness to adopt new livelihood strategies, all (n=30) respondents were quite uncomfortable and reluctant to answer. Finally, after facilitating a discussion about a scenario 'without livestock in the future', 25 respondents suggested that they were willing to pursue alternative livelihoods. Four people chose not to answer the questions and only one person stated that they were unwilling, due to uncertainty.

"I am waiting for what is to come and will plan accordingly."

Access to credit was the preferred diversification strategy by 12 respondents; nine respondents stated that they would survive on their government pensions and three respondents said that they would borrow money from family members. A study carried out in the central highlands of Ethiopia by Bewket and Alemayehu (2017) revealed that access to credit provided a long-term adaptation strategy for people and 70% respondents reported accessing credit in order to differentiate and increase household incomes. The study also revealed that farmers in Ethiopia depended on remittances from relatives working abroad as a coping strategy to climate change and variability (Bewket and Alemayehu, 2017). In another study carried out in Mbitini, Kenya, Eriksen, Brown and Kelly (2005) posit that cash incomes received from family members working away from home were integral to households coping with droughts in the region.

"When I do not have livestock, I will survive on government pension till I die."

"I will borrow money from my family and pray to God for help."

"If my family did not have livestock, I would take a loan from somewhere and buy a cow and pay back the money when my family had it."

Non-farm and off-farm incomes were the second most popular choice of income diversification among communal farmers in the study. A total of thirteen respondents had a clear idea of what they would do if they did not have any livestock; of which eight farmers preferred diversifying into non-farm incomes, for instance owning a *shabeen* or running a restaurant or gemstone mining. Five farmers preferred off-farm incomes like weaving baskets or selling firewood or herding other people's cattle. These findings align with those in Kenya, Ghana, Ethiopia and India, where pastoralists resorted to supplementing existing livestock-based livelihoods with alternate non-farm activities like microenterprise, selling firewood and casual wage labour; and off-farm activities like selling thatched grass and various other bush products as a coping mechanism to climate shocks (Little et al., 2001; Berhanu et al.,2007; Wren and Speranza, 2010; Gachathi and Eriksen, 2011; Murendo et al., 2011; Favretto et al., 2014; Opiyo et al., 2015; Rahut et al., 2015; Enns and Bersaglio, 2016; Akinyemi, 2017; Yambat et al., 2017)

"I will try for a job or else I'll sell bottles [of beer] at a shabeen."

"If I am working, but I still do not have livestock, I will go to South Africa and learn gemstone mining.

"I can weave baskets and sell them"

"I will plough other people's fields and get mahangu"

"I will collect firewood and sell it."

Some respondents (6.6%) expressed that they practiced mixed farming and stated that they would try and sell mahangu from their fields until they were able to get livestock. This kind of coping mechanism is practiced in parts of Kenya where farmers typically produce staple crops, drought-resistant crops, commercial crops along with rearing indigenous and exotic livestock breeds (Kariuki et al., 2007; Silvestri et al., 2007) Mixed farming as a diversification strategy is often used by smallholder farmers as a risk-reduction technique and to maximize profits from sales (Kariuki et al., 2007).

Through the interviews, there was a sense of reluctance to sell any livestock among the respondents, however two respondents somewhat begrudgingly confessed to adopting livestock destocking as an adaptation strategy if the need arose. Destocking livestock as an adaptation strategy has long-term benefits of improving communal grazing lands and also farmers' purchasing power (Morton and Barton, 2002). Examples from studies conducted in Ethiopia and Kenya indicate that pastoralists who practiced livestock off-take as a regular adaptation strategy were food secure and had surplus funds to cope with immediate and future climatic stresses as compared to those who did not; pastoralists who employed livestock mobility as a risk-reduction strategy found that they had sufficient access to rangelands and water which helped them diminish the effects of the drought and livestock disease (Opiyo et al., 2015; Alemayehu and Bewket, 2017) .

"Even if I have to sell cows for money, I will not sell all my livestock but only sell a few [cows]."

6.4 Barriers to selling livestock in the Omusati Region

The findings indicate livestock sales among communal farmers in the Omusati region are inhibited by numerous barriers that can be broadly grouped as culture, economic, information and institutional. The imminent impacts of climate change coupled with the

reluctance to selling livestock will threaten livelihoods and food security in the future. Some adaptation is already taking place in other semi-arid regions and these strategies reviewed in the literature could be integrated in northern Namibia. However, supportive methods are needed to encourage adaptation among communal farmers in order to reduce their vulnerability to climate change. Some methods include access to credit and financial institutions, access to information and training through extension officers, better infrastructure within communal areas and improved market access. When these methods are effectively established, they can facilitate adaptation among communal farmers and prompt them to sell their livestock and pursue alternate livelihood strategies, thereby mitigating their risk to future climate change.

Chapter Seven: Conclusions and Recommendations

7.1 Conclusion

The overarching aim of the study was to analyse the barriers to selling livestock in the face of a drought in the Omusati Region of North Central Namibia. This was carried out by assessing the purpose of livestock among communal farmers in the Omusati Region of North Central Namibia, understanding perceptions of communal livestock farmers regarding current and future droughts with respect to the sale of livestock and analysing the barriers to selling livestock so as to improve the lives of communal farmers in the Omusati Region.

Barriers are defined as normative, cognitive and institutional factors that obstruct individuals or societies from adopting suitable adaptation strategies in the face of climate change. In order to achieve the aim, this study sought to first assess the purpose of livestock among communal farmers in the Omusati Region; how livestock is distributed among households in north central Namibia and why livestock is integral to the lives of communal farmers. The study then went on to understanding the perception of communal farmers regarding current and future droughts with respect to the sale of livestock; do communal farmers perceive themselves to be vulnerable to climate change and examine the viability of keeping livestock via a cost benefit analysis. Lastly, an analysis of barriers to selling livestock so as improve the lives of communal farmers in the Omusati Region was carried out; what are the barriers to selling livestock, what are alternate livelihood diversification strategies adopted by communal farmers in semi-arid regions, and are communal farmers in Onesi willing to try new practice.

How is livestock distributed among households in north central Namibia?

The study showed that in most households in the Omusati Region, livestock was owned by older male members. Female household members usually managed agriculture and household duties, unless they were the oldest surviving members of the household among that particular generation. In terms of livestock distribution, the number of goats surpassed the number of cattle and donkeys; even though cattle were the most popular choice of livestock across the three villages – Okathitukeengombe, Oshihau and Omahanene. Donkeys were the least favoured livestock choice among households and were primarily used as drought power. As discussed in Chapter four, the problem of low cattle numbers was an outcome of the

droughts faced in the region that led to an increase in cattle mortality rate when compared to goats and donkeys. This objective was met with the information was inferred from Part I of the semi-structured interview.

Why is livestock integral to the lives of communal farmers?

As discussed in the literature review and in Chapter four, livestock, especially cattle play a vital socio-economic role in the lives of communal farmers in the Omusati Region; farmers rely on livestock as a primary or supplementary source of livelihood. In fact, even during the semi-structured interviews, there was a strong sense of guilt and shame among farmers who lost their livestock to the drought. Among all three villages, farmers professed that they would make relentless efforts to obtain livestock for themselves and their families till their dying day. This could be because owning livestock are symbolic of wealth and stature in the Aawambo tribe and men who did not own livestock were looked down upon by their families (especially their wife and children) and society in general. The study found that communal farmers firmly believed that livestock were the answer to their financial perils. During times of unforeseen emergencies or climate-shocks, farmers would often sell their livestock and procure money for their households.

Do communal farmers perceive themselves to be vulnerable to climate change?

The vulnerability of communal farmers to climate change was assessed in Chapter five through the impact of drought on livestock, which consequently affected their livelihoods. Farmers perceived change in climate (increased temperature and decreased rainfall) through the deterioration of animal health due to lack of feed availability and lack of water. The study also revealed the perceptions of future droughts in the Omusati region among the farmers, where a vast majority of farmers perceived droughts to get worse in the future or were uncertain of future drought scenarios. Despite this perception, nearly all the farmers were adamant about holding on to their livestock. Given that livestock numbers have reduced in the region and that farmers will continue to hold onto livestock in the future, this demonstrates that they do not perceive themselves to be vulnerable to climate change. Additionally, frequent variability in local climates in this region make it harder for farmers to fathom climate associated risks as for most farmers climate variability is a usual occurrence. Thus, there is a gap between local experience and scientific knowledge about the expected change in climate in the Omusati Region. This gap was not explored in the scope of this study and calls for further research.

Is it viable for communal farmers to keep livestock? – A cost benefit analysis

The main purpose of conducting a CBA was to gauge the economic viability of holding livestock during a drought, and if it would be more beneficial to communal farmers to sell their livestock through formal marketing channels like MeatCo. Using the Benefit Cost ratio method results from the CBA in Chapter five revealed that selling livestock through formal channels was more beneficial to farmers than keeping livestock. Selling livestock could provide a substantial income for poor households and in turn improve food security. The present norm of holding livestock seems counterproductive for communal farmers as the main outlay of their primary incomes is livestock related expenses which do not in turn yield supplementary incomes. This would then imply that instead of livestock being a means of reducing risk, they in fact expose communal farmers to greater risk, making them more vulnerable to climate shocks.

What are the barriers to selling livestock?

The study shows that several constraints or barriers have prevented communal farmers from selling livestock. Having been identified in discussions during the interviews, these barriers were further addressed in Chapter six. Among the barriers to selling livestock, keeping livestock due to cultural values was popularly mentioned among communal farmers. Other barriers mentioned were lack of financial institutions, lack of access to information, and lack of markets. The absence of institutional support was also mentioned as a barrier. Cultural norms are intrinsic to the people of the Omusati region and they perceive livestock to be a symbol of wealth and stature. Overcoming this barrier would require years of unlearning. However, interventions can be conducted to address the other mentioned barriers. It is however imperative that these interventions be conceptualized on a multi-sectoral plane to address all inhibiting factors and to thus enable farmers to alter perceptions about selling their livestock.

What are alternate livelihood diversifying strategies adopted by communal farmers in semi-arid regions?

The systematic literature review conducted in Chapter six highlighted the various livelihood diversification strategies adopted in other semi-arid regions. These were identified as destocking livestock, off-farm incomes (within the agricultural sector), restocking livestock, cropping, non-farm incomes, access to credit, changing consumption patterns, mixed farming, and diversifying livestock herd. Of these, destocking livestock, off-farm incomes, and non-

farm incomes prove to be most popular. Given the similarities among countries that have diversified and the Omusati region, it can be reasonably inferred that these strategies could be successfully adopted by the Aawambo people, through cross-border dissemination of information. By doing this, countries with the same climate variability can not only reduce vulnerability to climate shocks but also improve existing strategies.

Are communal farmers in Onesi willing to try new practices?

The final part of the study addressed the communal farmers' willingness to adopt new livelihood strategies. During the interviews, the farmers were reluctant to consider a reality devoid of their livestock, and had to be presented with a worst-case scenario. In this situation, the majority were willing to diversify livelihoods. The preferred diversification strategy was access to credit through public and private sources, followed by non-farm and off-farm incomes ranging from owning a *shabeen* and running a restaurant, to weaving baskets and selling firewood. It was noteworthy that two respondents also admitted to livestock destocking, which as a strategy, has long-term benefits. It is clear that there is a need to inculcate a sense of urgency among communal farmers, given future climate predictions for Namibia, not as a worst-case scenario but as a harsh reality. One way of achieving this is through the employment of trained extension officers.

7.2 Recommendations

North-central Namibia is a semi-arid region characterized by severe climate variability and extreme events such as droughts, making life for rural communities in this region extremely challenging. These communities depend on rainfed agriculture and natural resources for their livelihoods, making them highly vulnerable to climate change. Thus, the Omusati Region poses an example of how poor marginalised communities will be affected by climate change globally, making this study site relevant. Considerations for this particular research calls for greater action to mitigate barriers that were frequently cited, namely – access to credit, access to information and access to markets.

7.2.1 Access to Credit

Keeping livestock as a means of financial security was a barrier to selling livestock stated by a majority of farmers due to lack of access to credit in the region (Chapter six). Therefore, access to alternative finance through public and private funding could prompt

destocking livestock and enable communal farmers in the region to adopt diverse livelihoods, thereby increasing their resilience to climate change. Furthermore, during financial crises communal farmers have typically resorted to borrowing money from neighbours and overseas family members. However, providing financing to these farmers would not only aid them during emergencies but also support other non-farm endeavours that they might consider adopting. One-way governments and private funding agencies can support poor communal farmers by funding and incentivizing microenterprises and non-farm livelihoods in communal areas of the north.

7.2.2 Access to Information

In the study, farmers stated that they lacked the required skills and information to explore alternative livelihoods (Chapter six). In light of this, relevant information through education, demonstration and communication is vital to enable farmers in the Omusati region to take appropriate action towards livelihood diversification. The only sources of information in all three villages in the study were through the radio, through village headmen and a few other traditional authorities. This kind of information does not reach all the farmers and therefore there is a vital need for traditional leaders, trained extension officers, climate champions and religious leaders to widely disseminate information to all communal farmers in the vicinity. Additionally, communal farmers in the region should have access to information. Farmers should be included in workshops and stakeholder meetings so as to facilitate information sharing on aspects of climate change and adaptation and build capacity to enable them to eventually be able to execute adaptive actions independently. Since cultural values and traditional knowledge play a large role in the lives of communal farmers, it is vital that the information is communicated with sensitivity, keeping in mind cultural nuances.

7.2.3 Access to Markets

Lack of markets was cited as a barrier to selling livestock among communal farmers in the Omusati region for a myriad of reasons which have been analysed and discussed in Chapter six. Some of the main inhibiting factors expressed by farmers during the semi-structured interviews were high transaction costs related to production and marketing, lack of trust, distance to markets and lack of market information. Some ways to mitigate the problems associated with marketing livestock in formal markets are:

- Providing farmers in the north communal areas with transportation facilities to and from informal markets since most of these farmers are too poor to afford vehicles

- Improving the quality of communal grazing lands, increasing water availability, building veterinary facilities to help farmers tackle and reduce livestock diseases, employing extension officers to educate farmers about best livestock farming practices and about abattoirs and livestock agents. Although this point does not directly relate to markets, it is worth mentioning as it relates to transaction cost (production costs) in the cattle marketing process. Providing communal farmers with these facilities could give them greater motivation to participate in formal markets.

- Building trust and ensuring transparency between large corporations like MeatCo and communal farmers to prompt livestock sales among farmers in the Omusati region.

Harsh living conditions and extreme vulnerability to climate change in north central Namibia demonstrates how climate change might affect the lives of communities living in climate hotspots across the world. While there are adaptation strategies to overcome the barriers to selling livestock and some farmers are exploring alternative livelihoods, it is not the only solution. The first step to successful adaptation is being able to anticipate and accept future climate risks. If farmers do not perceive that they are vulnerable, they will be reluctant to change their ways and will be governed by social norms and religious beliefs, thus making them more vulnerable to climate change. Therefore, it is integral to build adaptive capacity in these communities with the help of various stakeholders, like village headmen and religious leaders, who can help bring about mindset changes to the community. Once this process is underway, knowledge sharing through access to information, credit access and market access can be provided so as to help these communities to explore and adopt alternative livelihood options in order to build a sustainable future in the face of climate risks.

References

Adger, W.N., Agrawala, S., Mirza, M.M.Q., Conde, C., o'Brien, K., Pulhin, J., Pulwarty, R., Smit, B. and Takahashi, K., 2007. Assessment of adaptation practices, options, constraints and capacity. *Climate change*, *200*.

Adger, W.N., Arnell, N.W. and Tompkins, E.L., 2005. Successful adaptation to climate change across scales. *Global environmental change*, *15*(2), pp.77-86.

Adger, W.N., Dessai, S., Goulden, M., Hulme, M., Lorenzoni, I., Nelson, D.R., Naess, L.O., Wolf, J. and Wreford, A., 2009. Are there social limits to adaptation to climate change?. *Climatic change*, *93*(3-4), pp.335-354.

Adger, W.N., Huq, S., Brown, K., Conway, D. and Hulme, M., 2003. Adaptation to climate change in the developing world. *Progress in development studies*, *3*(3), pp.179-195.

Agrawal, A. and Perrin, N., 2009. Climate adaptation, local institutions and rural livelihoods. *Adapting to climate change: thresholds, values, governance*, pp.350-367.

Akinyemi, F.O., 2017. Climate change and variability in semiarid palapye, eastern Botswana: an assessment from smallholder farmers' perspective. *Weather, Climate, and Society*, *9*(3), pp.349-365.

Alemayehu, A. and Bewket, W., 2017. Smallholder farmers' coping and adaptation strategies to climate change and variability in the central highlands of Ethiopia. *Local Environment*, *22*(7), pp.825-839.

Angula, M.N. and Kaundjua, M.B., 2016. The changing climate and human vulnerability in north-central Namibia. Jàmbá: Journal of Disaster Risk Studies, 8(2), pp.1-7.

Anon (2018) Pastoralism and Conflict in the Horn of Africa and the Sahel. [Online] 44 (4), 857–860.

Arbuckle, J.G., Morton, L.W. and Hobbs, J., 2013. Farmer beliefs and concerns about climate change and attitudes toward adaptation and mitigation: Evidence from Iowa. Climatic Change, 118(3-4), pp.551-563.

Ashley, C., 2000. The impacts of tourism on rural livelihoods: Namibia's experience. London: Overseas Development Institute.

Bailey, D., Barrett, C., Little, P. and Chabari, F., 1999. Livestock markets and risk management among East African pastoralists: A review and research agenda.

Bank, W., 2004. World Development Report 2004: Making services work for poor people. World Development Report.

Barbour, R., 2013. Introducing qualitative research: a student's guide. Sage.

Barnes, J.I., MacGregor, J. and Alberts, M., 2012. Expected climate change impacts on land and natural resource use in Namibia: exploring economically efficient responses. Pastoralism: Research, Policy and Practice, 2(1), p.22.

Barnett, J., Evans, L.S., Gross, C., Kiem, A.S., Kingsford, R.T., Palutikof, J.P., Pickering, C.M. and Smithers, S.G., 2015. From barriers to limits to climate change adaptation: path dependency and the speed of change.

Barrett, C. and Reardon, T., 2000. Asset, activity, and income diversification among African agriculturalists: Some practical issues.

Barrett, C.B., Reardon, T. and Webb, P., 2001. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. Food policy, 26(4), pp.315-331.

Barrett, J.C., 1992. *The economic role of cattle in communal farming systems in Zimbabwe*. London: Overseas Development Institute.

Bayer, W., Alcock, R. and Gilles, P., 2004, October. Going backwards?–moving forward?–Nguni cattle in communal Kwazulu-Natal. In Deutscher Tropentag. Humboldt-Universitätzu, Berlin: Rural Poverty Reduction through Research for Development and Transformation.

Becken, Susanne et al. (2013) The cultural context of climate change impacts: Perceptions among community members in the Annapurna Conservation Area, Nepal. Environmental Development. [Online] 8 (1), 22–37.

Berhanu, W. and Beyene, F., 2015. Climate variability and household adaptation strategies in Southern Ethiopia. *Sustainability*, *7*(6), pp.6353-6375.

Berhanu, W., Colman, D. and Fayissa, B., 2007. Diversification and livelihood sustainability in a semi-arid environment: A case study from southern Ethiopia. The Journal of Development Studies, 43(5), pp.871-889.

Berhe, M., Hoag, D., Tesfay, G., Tadesse, T., Oniki, S., Kagatsume, M. and Keske, C.M., 2017. The effects of adaptation to climate change on income of households in rural Ethiopia. *Pastoralism*, *7*(1), p.12.

Bewket, Woldeamlak & Alemayehu, Arragaw (2017) Smallholder farmers' coping and adaptation strategies to climate change and variability in the central highlands of Ethiopia. *Local environment.* [Online] 22 (7), 825–839.

Biesbroek, G.R., Klostermann, J.E., Termeer, C.J. and Kabat, P., 2013. On the nature of barriers to climate change adaptation. *Regional Environmental Change*, *13*(5), pp.1119-1129.

Bilsborrow, R.E., 2002. Migration, population change, and the rural environment. Environmental Change and Security Project Report, 8(1), pp.69-84.

Bishi, A. and Kamwi, J.A., 2008. *Veterinary science, transboundary animal diseases and markets: pathways for policy in Namibia, Transboundary animal disease and market access: future options for the beef industry in southern Africa*. Working Paper 4, Brighton: Institute of Development Studies. www. steps-centre. org/ourresearch/vetscience. html.

Blench, R., 2001. 'You Can't Go Home Again': Pastoralism in the New Millennium (p. 103). London: Overseas Development Institute.

Boardman A., Greenberg D., Vining A., Weimer D. 2014. Cost-Benefit Analysis. 4th Edition. The Pearson Series in Economics.

Boko, M., Niang, I., Nyong, A., & Vogel, C., et al. (2007). Africa. In M. L. Parry, O. F. Canziani, J. P. Palutikof et al. (Eds.), Climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 433–467). Cambridge: Cambridge University Press.

Brundtland, G., Khalid, M., Agnelli, S., Al-Athel, S., Chidzero, B., Fadika, L., Hauff, V., Lang, I., Shijun, M., de Botero, M.M. and Singh, M., 1987. Our common future (\'brundtland report\').

Brüssow, K., Faße, A. and Grote, U., 2017. Implications of climate-smart strategy adoption by farm households for food security in Tanzania. *Food security*, *9*(6), pp.1203-1218.

Calzadilla, A., Zhu, T., Rehdanz, K., Tol, S. J. R., & Ringler, C. (2008). Economic-wide impacts of climate change on agriculture in Sub Saharan Africa. University of Hamburge Working Paper FNU-170, Hamburg, Germany.

Campbell, D. J. 1999. Response to drought among farmers and herders in southern Kajiaro District, Kenya: a comparison of 1972–76 and 1994–95. Human Ecology, 27: 377–417.

Chambers, R., 1989. Editorial introduction: vulnerability, coping and policy. IDS bulletin, 20(2), pp.1-7.

Chimonyo M, Kusina NT, Hamudikuwanda H, Nyoni O (1999). A survey on land use and usage of cattle for draught in a smallholder farming area of Zimbabwe. J. Appl. Sci. Southern Afr. 5(2): 111-121

Coertze, R.D., 1986. Livestock in the social and cultural life of African communities. *South African Journal of Ethnology*, *9*(3), pp.129-135.

Coetzee, L., Montshwe, B.D. and Jooste, A., 2005. The marketing of livestock on communal lands in the Eastern Cape Province: Contraints, challenges and implications for the extension services. South African Journal of Agricultural Extension, 34(1), pp.81-103.

Collier, W.L. and Wiradi, G., 1988. A preliminary study of employment trends in lowland Javanese villages. Agency for Agricultural Research and Development, Bogor, Indonesia.

COLVIN, PM. 1985. *Welfare economics and African pastoralism: a southern African literature review of the socio-economic features arising from traditional cattle ownership and production*, Monograph No 3 Pietermaritzburg: Institute for Natural Resources. unpublished report [Google Scholar]

Cousins, B., 1999. Invisible capital: The contribution of communal rangelands to rural livelihoods in South Africa. Development Southern Africa, 16(2), pp.299-318.

Cunningham, A.B., 1997. Landscape domestication and cultural change: human ecology of the Cuvelai-Etosha region. Madoqua, 20(1), pp.37-48.

Davies, J., Spear, D., Chappel, A., Joshi, N., Togarepi, C. and Kunamwene, I., 2019. Considering Religion and Tradition in Climate Smart Agriculture: Insights from Namibia. In *The Climate-Smart Agriculture Papers* (pp. 187-197). Springer, Cham.

Davis, C.L. 2011. Climate risk and vulnerability: a handbook for Southern Africa. Council for Scientific and Industrial Research, Pretoria, South Africa, 92pp.

Davis, C.L. and Vincent, K., 2017. Climate risk and vulnerability: A handbook for Southern Africa.

De Bruijn, M. and Van Dijk, H., 2003. Changing population mobility in West Africa: Fulbe pastoralists in central and south Mali. African Affairs, 102(407), pp.285-307.

De Bruyn, P., De Bruyn, J.N., Vink, N. and Kirsten, J.F., 2001. How transaction costs influence cattle marketing decisions in the northern communal areas of Namibia. Agrekon, 40(3), pp.405-425.

De Lange, A.O., 1994. Communal farming in arid regions. Karoo Agric, 6(1), pp.12-16.

Delgado, C., 1999. Sources of growth in smallholder agriculture in Sub Saharan Africa: The role of vertical integration of smallholders with processors and marketers of high value-added items. Agrekon, 38, pp.165-189.

Dercon, S., 1998. Wealth, risk and activity choice: cattle in Western Tanzania. Journal of Development Economics, 55(1), pp.1-42.

Devereux, S. and Naeraa, T., 1996. Drought and survival in rural Namibia. Journal of Southern African Studies, 22(3), pp.421-440.

Devereux, S., 1995. The 1992/3 drought in Namibia: an evaluation of its socio-economic impact on affected households.

Douglass, C., 1990. North, Institutions, institutional change and economic performance.

Dovie, D.B., Shackleton, C.M. and Witkowski, E.T.F., 2006. Valuation of communal area livestock benefits, rural livelihoods and related policy issues. Land use policy, 23(3), pp.260-271.

Dube, O.P. and Sekhwela, M.B.M., 2007. Community coping strategies in Semiarid Limpopo basin part of Botswana: Enhancing adaptation capacity to climate change. *Washington, DC: AIACC*.

Düvel, G.H. and Stephanus, A.L., 2000. A comparison of economic and cultural incentives in the marketing of livestock in some districts of the northern communal areas of Namibia. Agrekon, 39(4), pp.656-664.

Düvel, G.H., 2002. Livestock marketing in northern Namibia: cultural versus economic incentives. South African Institute for Agricultural Extension. University of Pretoria, Pretoria.

DWA. 1991. Perspective on water affairs. Department of Water Affairs, Ministry of Agriculture, Water and Rural Development. Windhoek.

Eakin, H., & Luers, A. L. (2006). Assessing the vulnerability of social-environmental systems. *Annu. Rev. Environ. Resour.*, *31*, 365-394.

Einzig, P., 1949. Primitive Money in its Ethnological. Historical and Economic Aspects, London.

Ellis, F. and Freeman, H.A., 2004. Rural livelihoods and poverty reduction strategies in four African countries. Journal of development studies, 40(4), pp.1-30.

Ellis, F., 1993. Peasant economics: Farm households in agrarian development (Vol. 23). Cambridge University Press.

Ellis, F., 1998. Household strategies and rural livelihood diversification. The journal of development studies, 35(1), pp.1-38.

Ellis, F., 2000. Rural livelihoods and diversity in developing countries. Oxford university press.

Ellis, F., 2000. The determinants of rural livelihood diversification in developing countries. Journal of Agricultural Economics, 51(2), pp.289-302.

Elmqvist B, Olsson L (2006) Livelihood diversification: continuity and change in the Sahel. GeoJournal 67:167–180

Enns, C. and Bersaglio, B., 2016. Pastoralism in the time of oil: Youth perspectives on the oil industry and the future of pastoralism in Turkana, Kenya. *The Extractive Industries and Society*, *3*(1), pp.160-170.

Eriksen, S.H., Brown, K. and Kelly, P.M., 2005. The dynamics of vulnerability: locating coping strategies in Kenya and Tanzania. Geographical Journal, 171(4), pp.287-305.

Fafchamps, M., Udry, C. and Czukas, K., 1998. Drought and saving in West Africa: are livestock a buffer stock?. Journal of Development economics, 55(2), pp.273-305.

FAO 2009. State of Food and Agriculture (SOFA). Livestock in the balance. FAO, Rome, Italy.

Favretto, N., Stringer, L.C. and Dougill, A.J., 2014. Unpacking livelihood challenges and opportunities in energy crop cultivation: perspectives on J atropha curcas projects in M ali. *The Geographical Journal*, *180*(4), pp.365-376.

Filipová, Z. and Johanisova, N., 2017. Changes in pastoralist commons management and their implications in Karamoja (Uganda). Journal of Political Ecology, 24(1), pp.881-900.

Food and Agriculture Organisation (FAO), 2004. Changing patterns of agricultural trade. The evolution of trade in primary and processed agricultural products.

Freeman, H.A., Kaitibie, S., Moyo, S. and Perry, B.D., 2008. Designing livestock interventions for emergency situations in Southern Africa.

Freeman, H.A., Kaitibie, S., Moyo, S. and Perry, B.D., 2008. Designing livestock interventions for emergency situations in Southern Africa.

Gachathi, F.N. and Eriksen, S., 2011. Gums and resins: The potential for supporting sustainable adaptation in Kenya's drylands. Climate and Development, 3(1), pp.59-70.

Gautam, Y. and Andersen, P., 2016. Rural livelihood diversification and household well-being: Insights from Humla, Nepal. Journal of Rural Studies, 44, pp.239-249.

Gautier, D., Denis, D. and Locatelli, B., 2016. Impacts of drought and responses of rural populations in West Africa: a systematic review. *Wiley Interdisciplinary Reviews: Climate Change*, *7*(5), pp.666-681.

Gill, P., Stewart, K., Treasure, E. and Chadwick, B., 2008. Methods of data collection in qualitative research: interviews and focus groups. British dental journal, 204(6), p.291.

Government of Namibia,Old Age and Disability Grant ,Ministry of Labour and Social Welfare, Windhoekhttp://www.gov.na/documents/10181/12007/Brochure_for_Disability.pdf/10d3e7f8-9d98-4ac2-9ea8-67de2c4a4b49. (2018).

Groenewald, J.A. and Jooste, A., 2012. Smallholders and livestock markets. In Unlocking markets to smallholders (pp. 113-131). Wageningen Academic Publishers, Wageningen.

Hangara, G.N., Teweldemedhin, M.Y. and Groenewald, I.B., 2011. Measuring factors that can influence cattle supply response to the market in Namibia: Case study from Omaheke communal farmers. Journal of Agricultural Extension and Rural Development, 3(8), pp.141-146.

Hanley N., Barbier E.B. 2009. Pricing Nature: Cost-Benefit Analysis and Environmental Policy. Edward Elgar, Cheltenham, UK.

Hartel, C.E.J. and Pearman, G.I., 2010. Understanding and responding to the climate change issue: towards a whole-of-science research agenda. Journal of Management and Organisation, 16 (1), 16–47.

Hartmann, A. (2019). Farmer's Support Project. Animal Health. Windhoek: Joint Presidency Committee (NAU and the NNFU), p.63.

Harvey, B., Diagne, B., Nnam, J., & Tadege, A. (2009). Knowledge Sharing for Climate Change Adaptation in Africa. *Opportunities and Challenges, Africa Adapt Guest article no. 73 on 5th July 2010*.

Hegga, S., Ziervogel, G., Angula, M., Spear, D., Nyamwanza, A., Ndeunyema1, E., Kunamwene, I., Togarepi, C. and Morchain, D. 2016. Vulnerability and Risk Assessment in the Omusati Region in Namibia: Fostering People-Centred Adaptation to Climate Change

Herrero, M., Thornton, P.K., Gerber, P. and Reid, R.S., 2009. Livestock, livelihoods and the environment: understanding the trade-offs. *Current Opinion in Environmental Sustainability*, *1*(2), pp.111-120.

Herrero, M., Thornton, P.K., Gerber, P., van der Zijpp, A., van de Steeg, J., Notenbaert, A.M., Lecomte, P. and Grace, D. 2010. The way forward on livestock and the environment. In: Swanepoel, F.J.C., Stroebel, A. & Moyo, S. (Eds) The role of livestock in developing communities: Enhancing multifunctionality. CTA, Wageningen, The Netherlands.

Holechek, J.L., 2002. Do most livestock losses to poisonous plants result from" poor" range management?. Journal of Range Management, pp.270-276.

Howden, S.M., Soussana, J.F., Tubiello, F.N., Chhetri, N., Dunlop, M. and Meinke, H., 2007. Adapting agriculture to climate change. Proceedings of the national academy of sciences, 104(50), pp.19691-19696.

Intergovernmental Panel on Climate Change (IPCC), 2014

Intergovernmental Panel on Climate Change (IPCC), 2014, 'Glossary', in J. Agard & L. Schipper (eds.), Contribution of working group II to the fifth assessment report, n.p., Cambridge University Press, Cambridge.

IPCC. 2014b. International Panel on Climate Change. Climate change synthesis report

Jari, B. and Fraser, G., 2012. 3. Influence of institutional and technical factors on market choices of smallholder farmers in the Kat River Valley. Mansholt publication series-Volume 10 edited by: Herman D. van Schalkwyk Jan A. Groenewald, p.59.

Kaakunga, E. and Ndalikokule, V., 2006. Property rights and access to credit. Bank of Namibia Research Department.

Kaida, K., Nishikawa, Y., Benisiu, T., Shivolo, O. and Hango, V., 2017. What encourages households to adopt rice as a new crop? Understanding gender roles and perceptions in households in northern Namibia. *Development in Practice*, *27*(7), pp.952-964.

Kariuki, P.C., Iiyama, M. and Maitima, J., 2007. Crop-livestock diversification patterns in relation to income and manure use: a case study from a Rift Valley community, Kenya.

Katjiua, M. & Ward, D. (2007) Pastoralists' perceptions and realities of vegetation change and browse consumption in the northern Kalahari, Namibia. *Journal of Arid Environments*. [Online] 69 (4), 716–730.

Kherallah, M. and Kirsten, J.F., 2002. THE NEW INSTITUTIONAL ECONOMICS: APPLICATIONS FOR AGRICULTURAL POLICY RESEARCH IN DEVELOPING COUNTRIES: "New institutional economists are the blue-collar guys with a hearty appetite for reality." Oliver Williamson, 2000a. Agrekon, 41(2), pp.110-133.

Klintenberg, P., Seely, M. and Christiansson, C., 2006. Local and national perceptions of environmental change in central Northern Namibia: Do they correspond?. Journal of arid environments, 69(3), pp.506-525.

Koluman, D. N., & Silanikove, N. (2017). The advantages of goats for future adaptation to Climate Change: A conceptual overview. Small Ruminant Research.

Kotir, J.H., 2011. Climate change and variability in Sub Saharan Africa: a review of current and future trends and impacts on agriculture and food security. *Environment, Development and Sustainability*, *13*(3), pp.587-605.

L. Schipper (eds.), Contribution of working group II to the fifth assessment report, n.p., Cambridge University Press, Cambridge.

Leichenko, R.M. and O'brien, K.L., 2002. The dynamics of rural vulnerability to global change: the case of southern Africa. Mitigation and adaptation strategies for global change, 7(1), pp.1-18. Outlook, C.E., 2002. Caucasus Environmental Outlook Report, completed through financial assistance provided by UNDP and Swiss Agency for Environment, Forest, and Landscape.

Leichenko, R.M. and O'brien, K.L., 2002. The dynamics of rural vulnerability to global change: the case of southern Africa. Mitigation and adaptation strategies for global change, 7(1), pp.1-18.

Liberman N, Trope Y. The psychology of transcending the here and now. Science, 2008; 322:1201–1205.

Little, P.D., Smith, K., Cellarius, B.A., Coppock, D.L. and Barrett, C., 2001. Avoiding disaster: diversification and risk management among East African herders. Development and change, 32(3), pp.401-433.

Mack, N., Woodsong, C., MacQueen, K.M., Guest, G. and Namey, E., 2005. Qualitative research methods: a data collectors field guide.

Marius, L.N., 2017. *Evaluation of local feed resources, their response on intake, growth, milk yield and composition and product properties of Namibian indigenous goats* (Doctoral dissertation).

Marius, L.N., Kandjou-Hambeka, M. and Jakob, A.M. 2012. Characterization of the Dairy Production System Practiced by the Livestock keepers in the selected constituencies of Namibia: A Case of Omuthiya-Guinas and Ovitoto. In: Agricola 2012. Directorate of Agricultural Research and Development, Ministry of Agriculture, Water and Forestry, Windhoek, Namibia

Martin, S.M. and Lorenzen, K.A.I., 2016. Livelihood diversification in rural Laos. *World Development*, *83*, pp.231-243.

Maru, Y.T., Smith, M.S., Sparrow, A., Pinho, P.F. and Dube, O.P., 2014. A linked vulnerability and resilience framework for adaptation pathways in remote disadvantaged communities. *Global Environmental Change*, *28*, pp.337-350.

Matanyaire, C.M., 1996. Farmers' production practices and perceptions of problems as a guide for research on rain fed food crops in northern Namibia. Development Southern Africa, 13(5), pp.681-691.

May, J., Carter, M.R. and Posel, D., 1995. The composition and persistence of poverty in rural South Africa: An entitlements approach to poverty. Land and Agriculture Policy Centre.

McCabe, J.T., 2003. Sustainability and livelihood diversification among the Maasai of northern Tanzania. Human Organization, 62(2), pp.100-111.

McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S. eds., 2001. Climate change 2001: impacts, adaptation, and vulnerability: contribution of Working Group II to the third assessment report of the Intergovernmental Panel on Climate Change (Vol. 2). Cambridge University Press.

McPeak, J.G. and Barrett, C.B., 2001. Differential risk exposure and stochastic poverty traps among East African pastoralists. American Journal of Agricultural Economics, 83(3), pp.674-679.

Meat Corporation of Namibia (MeatCo) Date Accessed July 15, 2019 https://www.MeatCo.com.na/about-us/average-price/148/

Megersa, B., Markemann, A., Angassa, A., Ogutu, J.O., Piepho, H.P. and Zárate, A.V., 2014. Livestock diversification: an adaptive strategy to climate and rangeland ecosystem changes in southern Ethiopia. *Human ecology*, *42*(4), pp.509-520.

Meissner, H.H., Scholtz, M.M. and Engelbrecht, F.A., 2013. Sustainability of the South African Livestock Sector towards 2050 Part 2: Challenges, changes and required implementations. South African Journal of Animal Science, 43(3), pp.289-319.

Mendelsohn, J.M., El Obeid, S. and Roberts, C., 2000. A profile of north-central Namibia. Gamsberg Macmillan Publishers.

Mendelsohn, R. and Seo, S.N., 2007. Climate change adaptation in Africa: a microeconomic analysis of livestock choice. The World Bank.

Mertz, O., Mbow, C., Reenberg, A. and Diouf, A., 2009. Farmers' perceptions of climate change and agricultural adaptation strategies in rural Sahel. *Environmental management*, *43*(5), pp.804-816.

Metzger, D., 1994. Livestock sector study for Hereroland and Namaland. Min. of Agriculture, Water and Rural Development.

Midgley, G. et al., 2005. Assessment of potential climate change impacts on Namibia's floristic diversity, ecosystem structure and function, Kirstenbosch Botanical Garden, Cape Town: South African National Biodiversity Institute.

Ministry of Agriculture, water and Rural Development 1995, National Agriculture policy. Windhoek, Namibia

Mirza, M.M.Q., 2003. Climate change and extreme weather events: can developing countries adapt?. *Climate policy*, *3*(3), pp.233-248.

Mmbengwa, V., Nyhodo, B., Myeki, L., Ngethu, X. and van Schalkwyk, H., 2015. Communal livestock farming in South Africa: Does this farming system create jobs for poverty stricken rural areas. *Sylwan*, *159*(10), pp.176-192.

Moll, H.A., 2005. Costs and benefits of livestock systems and the role of market and nonmarket relationships. *Agricultural Economics*, *32*(2), pp.181-193.

Montshwe, B.D., 2006. Factors affecting participation in mainstream cattle markets by small-scale cattle farmers in South Africa (Doctoral dissertation, University of the Free State).

Morton, J. and Barton, D., 2002. Destocking as a drought–mitigation strategy: clarifying rationales and answering critiques. *Disasters*, *26*(3), pp.213-228.

Morton, J.F., 2007. The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the national academy of sciences*, *104*(50), pp.19680-19685.

Moser, S.C. and Ekstrom, J.A., 2010. A framework to diagnose barriers to climate change adaptation. *Proceedings of the national academy of sciences*, *107*(51), pp.22026-22031.

Moyo, M., Mvumi, B.M., Kunzekweguta, M., Mazvimavi, K., Craufurd, P. and Dorward, P., 2012. Farmer perceptions on climate change and variability in semi-arid Zimbabwe in relation to climatology evidence. African Crop Science Journal, 20(2), pp.317-335.

Moyo, S. and Swanepoel, F.J.C., 2010. Multifunctionality of livestock in developing communities. The role of livestock in developing communities: Enhancing multifunctionality, p.1.

Müller, C., Cramer, W., Hare, W.L. and Lotze-Campen, H., 2011. Climate change risks for African agriculture. Proceedings of the National Academy of Sciences, 108(11), pp.4313-4315.

Murendo, C., Keil, A. and Zeller, M., 2011. Drought impacts and related risk management by smallholder farmers in developing countries: evidence from Awash River Basin, Ethiopia. Risk Management, 13(4), pp.247-263.

Musemwa, L., Chagwiza, C., Sikuka, W., Fraser, G., Chimonyo, M. and Mzileni, N., 2007. Analysis of cattle marketing channels used by small scale farmers in the Eastern Cape Province, South Africa. *Livestock Research for Rural Development*, *19*(9), p.131.

Musemwa, L., Mushunje, A., Chimonyo, M., Fraser, G., Mapiye, C. and Muchenje, V., 2008. Nguni cattle marketing constraints and opportunities in the communal areas of South Africa. African Journal of Agricultural Research, 3(4), pp.239-245.

Mutibvu, T., Maburutse, B.E., Mbiriri, D.T. and Kashangura, M.T., 2012. Constraints and opportunities for increased livestock production in communal areas: A case study of Simbe, Zimbabwe. Livestock Research for Rural Development, 24(9).

Mwenya, E. and Keib, G., 2004. History and utilisation of donkeys in Namibia. Donkeys, People and Development: a Resource Book for Eastern and Southern Africa, ATNESA, Wageningen, pp.172-174.

NARIS, 2001. National Agriculture Resources Information System. Unpublished GIS data collection, Agro-Ecological Zoning Program, Ministry of Agriculture, Water and Rural Development, Windhoek

National Planning Commission, 2012. Namibia 2011 population and housing census preliminary results. Windhoek, Namibia.

Naudé, T.W., Kellerman, T.S. and Coetzer, J.A.W., 1996. Plant poisonings and mycotoxicoses as constraints in livestock production in East Africa: the southern African experience. Journal of the South African Veterinary Association, 67(1), pp.8-11.

Naziri, D., Rich, K.M. and Bennett, B., 2015. Would a commodity-based trade approach improve market access for Africa? A case study of the potential of beef exports from communal areas of Namibia. *Development Policy Review*, *33*(2), pp.195-219.

Newsham, A, J. and Thomas, D. 2009. Agricultural adaptation, local knowledge and livelihoods diversification in North-Central Namibia. Tyndall centre for climate change research.

Newsham, A.J. and Thomas, D.S., 2011. Knowing, farming and climate change adaptation in North-Central Namibia. Global Environmental Change, 21(2), pp.761-770.

Niehof, A., 2004. The significance of diversification for rural livelihood systems. Food policy, 29(4), pp.321-338.

Nkosi, S.A. and Kirsten, J.F., 1993. THE MARKETING OF LIVESTOCK IN SOUTH AFRICA'S DEVELOPING AREAS: A CASE STUDY OF THE ROLE OF SPECULATORS, AUCTIONEERS, BUTCHERS AND PRIVATE BUYERS IN LEBOWA/Die bemarking van lewende hawe in die minder-ontwikkelde gebiede van Suid-Afrika:'n Gevallestudie van die rol van veespekulante, afslaers, slagters en privaat kopers in Lebowa. Agrekon, 32(4), pp.230-237.

NSA 2011. National Statistics Agency, Omusati Regional Profile, Population and Housing Census, 182 pp

NSA 2018. National Statistics Agency, Namibia Census of Agriculture Communal Sector Report,

NSA. 2012. National Statistics Agency, Poverty dynamics in Namibia: A comparative study using the 1993/94, 2003/04 and the 2009/10 NHIES surveys. Report, 45 pp.

Nyanga, P.H., Johnsen, F.H. and Aune, J.B., 2011. Smallholder farmers' perceptions of climate change and conservation agriculture: evidence from Zambia.

Odendaal, W., 2011, April. Land Grabbing in Namibia: A case study from the Omusati region, northern Namibia. In International conference on global land grabbing (pp. 6-8).

Oettle, N., Fakir, S., Wentzel, W., Giddings, S. and Whiteside, M., 1998. Encouraging sustainable smallholder agriculture in South Africa. Environment and Development Consultancy Ltd, Wales.

O'farrell, P.J., Anderson, P.M.L., Milton, S.J. and Dean, W.R.J., 2009. Human response and adaptation to drought in the arid zone: lessons from southern Africa. *South African Journal of Science*, *105*(1-2), pp.34-39.

Ogalleh, S.A., Vogl, C.R., Eitzinger, J. and Hauser, M., 2012. Local perceptions and responses to climate change and variability: The case of Laikipia District, Kenya. Sustainability, 4(12), pp.3302-3325.

Onono, J.O., Amimo, J.O. and Rushton, J., 2015. Constraints and efficiency of cattle marketing in semiarid pastoral system in Kenya. *Tropical animal health and production*, *47*(4), pp.691-697.

Opiyo, F., Wasonga, O., Nyangito, M., Schilling, J. and Munang, R., 2015. Drought adaptation and coping strategies among the Turkana pastoralists of northern Kenya. *International Journal of Disaster Risk Science*, *6*(3), pp.295-309.

Ortmann, G.F. and King, R.P., 2006. *Small-scale farmers in South Africa: Can agricultural cooperatives facilitate access to input and product markets?* (No. 1701-2016-139140).

Ouma, E.A., Obare, G.A. and Staal, S.J., 2003, August. Cattle as assets: assessment of non-market benefits from cattle in smallholder Kenyan crop-livestock systems. In Proceedings of the 25th International Conference of Agricultural Economists (IAAE) (pp. 16-22).

Patt, A.G. and Schröter, D., 2008. Perceptions of climate risk in Mozambique: implications for the success of adaptation strategies. Global Environmental Change, 18(3), pp.458-467.

Preston, D.A., 1989. Too busy to farm: Under-utilisation of farmland in central Java. The Journal of development studies, 26(1), pp.43-57.

Pritchard, W.R., Doyle, J.J., Fitzhugh, H., De Haan, C., Lynam, J., Mc Gillivray, I., Masiga, W., Peberdy, J., Sawadogo, A. and Tacher, G., 1992. *Assessment of animal agriculture in Sub Saharan Africa*. Winrock International.

Rahut, D., Ali, A., Castellanos, I.V. and Sahoo, P., 2015. Market participation by subsistence farmers: evidence from the Himalayas. *JAPS*, *25*(6), pp.1713-1721.

Reid, H., 2007. The economic impact of climate change in Namibia: how climate change will affect the contribution of Namibia's natural resources to its economy (Vol. 7, No. 2). IIED.

Reid, H., Sahlen, L., Stage, J. and MacGregor, J. 2008. Climate change impacts on Namibia's natural resources and economy, Climate Policy, 8(5): 452-466,

Reid, R.S., Galvin, K.A. and Kruska, R.S., 2008. Global significance of extensive grazing lands and pastoral societies: an introduction. In *Fragmentation in semi-arid and arid landscapes* (pp. 1-24). Springer, Dordrecht.

Republic of Namibia, 2011, Second national communication of the Republic of Namibia to the United Nations framework convention on climate change, Ministry of Environment and Tourism, Windhoek.

Ringius, L., Downing, T. E., Hulme, M., Waughray, D., & Selrod, R. (1996). Climate change in Africa— Issues and Challenges in agriculture and water for sustainable development. Centre for International Climate and Environmental Research-Oslo (CICERO), University of Oslo, Norway. ISSN: 0804-4562

Rothauge, A., 2001. An evaluation of open rotational grazing. *Agricola*, *12*, pp.94-98.

Rothauge, A.X.E.L., 2001. Drought Management Strategies for Namibian Ranchers. *AGRICOLA, Windhoek*, pp.91-105.

Senaka Arachchi, R.B., 1998. Drought and household coping strategies among peasant communities in the dry zone of Sri Lanka.

Shackleton CM, Shackleton SE, Netshiluvhi TR, Mathabela FR, Phiri C, (1999). The direct use value of goods and services attributed to cattle and goats in the Sand River Catchment, Bushbuckridge, CSIR- Environmentek Report No. ENV-P-C 99003, CSIR, Pretoria.

Shackleton, C.M., Shackleton, S.E. and Cousins, B., 2001. The role of land-based strategies in rural livelihoods: the contribution of arable production, animal husbandry and natural resource harvesting in communal areas in South Africa. *Development Southern Africa*, *18*(5), pp.581-604.

Shah, K.U., Dulal, H.B., Johnson, C. and Baptiste, A., 2013. Understanding livelihood vulnerability to climate change: Applying the livelihood vulnerability index in Trinidad and Tobago. Geoforum, 47, pp.125-137.

Shah, M. M., Fischer, G., & van Velthuizen, H. (2008). Food security and sustainable agriculture: The challenges of climate change in Sub Saharan Africa. Laxenburg, Austria: International Institute for Applied Systems Analysis A-2361.

Shiimi, T., Taljaard, P.R. and Jordaan, H., 2012. Transaction costs and cattle farmers' choice of marketing channel in North-Central Namibia. Agrekon, 51(1), pp.42-58.

Siegmund-Schultze, M., Lange, F., Schneiderat, U. and Steinbach, J., 2012. Performance, management and objectives of cattle farming on communal ranges in Namibia. Journal of arid environments, 80, pp.65-73.

Silvestri, S., Bryan, E., Ringler, C., Herrero, M. and Okoba, B., 2012. Climate change perception and adaptation of agro-pastoral communities in Kenya. *Regional Environmental Change*, *12*(4), pp.791-802.

Smit, B., Burton, I., Klein, R.J. and Wandel, J., 2000. An anatomy of adaptation to climate change and variability. In *Societal adaptation to climate variability and change* (pp. 223-251). Springer, Dordrecht.

Smithers, J. and Smit, B., 1997. Human adaptation to climatic variability and change. *Global environmental change*, *7*(2), pp.129-146.

Soeters, S., Weesie, R. and Zoomers, A., 2017. Agricultural investments and farmer-fulani pastoralist conflict in West African drylands: A northern Ghanaian case study. *Sustainability*, *9*(11), p.2063.

Spear D., Zaroug M. A. H., Daron D.D., Ziervogel G., Angula M.N., Haimbili E.N., Hegga S.S., Baudoin M., New M., Kunamwene I., Togarepi C. and Davies J.E. 2018. Vulnerability and responses to climate change in drylands: The case of Namibia. CARIAA-ASSAR Working Paper. University of Cape Town, Cape Town, South Africa.

Spear, D. and Chappel, A., 2018. Livelihoods on the edge without a safety net: The case of smallholder crop farming in North-Central Namibia. *Land*, *7*(3), p.79.

Spear, D., Haimbili, E., Angula, M. N., Hegga, S., Zaroug, M. and Okeyo, A. 2016. Vulnerability and adaptation to climate change in semi-arid areas in southern Africa. CARIAA-ASSAR Working Paper. University of Cape Town, Cape Town, South Africa. 117pp

Spear, D., Haimbili, E., Angula, M., Baudoin, M.A., Hegga, S., Zaroug, M. and Okeyo, A., 2015. Vulnerability and Adaptation to Climate Change in the Semi-Arid Regions of Southern Africa.

Speir, I., Cabrera, R., Cochran, M., Dangelmayr, L., D'Aguilar, G., Gawande, K., Lee, J. and Weigand, C., 2007. African Capacity Building for Meat Exports: Lessons from the Namibian and Botswanan Beef Industries.

Spence, Alexa et al. (2012) The Psychological Distance of Climate Change. Risk Analysis. [Online] 32 (6), 957–972.

Speranza, C.I., 2010. Drought coping and adaptation strategies: understanding adaptations to climate change in agro-pastoral livestock production in Makueni district, Kenya. The European Journal of Development Research, 22(5), pp.623-642.

summary for policymakers. Report

Swanepoel, F., Stroebel, A. and Moyo, S., 2010. The role of livestock in developing communities: Enhancing multifunctionality. University of the Free State and CTA.

Sweet, J., 1997. Towards sustainable range management in communal areas. *AGRISSON (ed.)*, pp.56-87.

Sweet, J., 1998. Livestock–Coping with drought: Namibia–a case study. Pasture Development Network, Overseas Development Institute, London, United Kingdom.

Tapscott, C., 1993. National reconciliation, social equity and class formation in independent Namibia. Journal of Southern African Studies

Tapson, D.R. and Rose, C.J., 1984. An investigation into the KwaZulu cattle industry (No. 2-84). Agricultural and Rural Development Research Institute.

Tapson, D.R., 1991. *The overstocking and offtake controversy reexamined for the case of Kwazulu*. London: Overseas Development Institute.

Teweldemedhin, M.Y. and Kapimbi, Y., 2012. Factors influencing enterprise diversification as a risk strategy management in Namibia: a case study of communal farmers from the Kunene region. International Journal of AgriScience, 2(9), pp.845-853.

Thomalla, F., Smith, R. and Schipper, E.L.F., 2015. Cultural aspects of risk to environmental changes and hazards: a review of perspectives. In Disaster's Impact on Livelihood and Cultural Survival (pp. 44-59). CRC Press.

Thomas, David et al. (2007) Adaptation to climate change and variability: farmer responses to intra-seasonal precipitation trends in South Africa. *Climatic Change*. [Online] 83 (3), 301–322.

Thomas, K., Hardy, R.D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J.T., Rockman, M., Warner, B.P. and Winthrop, R., 2019. Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*, *10*(2), p.e565.

Thomson, G.R. 1999. Alternatives for controlling animal diseases resulting from interactions between livestock and wildlife in Southern Africa. South African Journal of Science 95: 71–76

Thornton, P.K., Boone, R.B. and Ramírez Villegas, J., 2015. Climate change impacts on livestock.

Thornton, P.K., van de Steeg, J., Notenbaert, A. and Herrero, M., 2009. The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agricultural systems*, *101*(3), pp.113-127.

Thornton, Philip et al. (2007) Coping Strategies in Livestock-dependent Households in East and Southern Africa: A Synthesis of Four Case Studies. *Human Ecology*. [Online] 35 (4), 461–476. [online].

Togarepi, C., Benisiu, T., Namutenya H., M., 2018 Why Goat Farming in Northern Communal Areas of Namibia Is not Commercialised: The Case of Ogongo Constituency. *In Journal of Sustainable Development; Vol. 11, No. 6; 2018*

Togarepi, C., Thomas, B. and Kankono, M., 2016. Cattle marketing constraints and opportunities in north-central communal areas of Namibia, Ohangwena Region. Livestock Research for Rural Development, 28, p.7.

Tsegaye, D., Vedeld, P. and Moe, S.R., 2013. Pastoralists and livelihoods: A case study from northern Afar, Ethiopia. Journal of Arid Environments, 91, pp.138-146.

Twomlow, S., Mugabe, F.T., Mwale, M., Delve, R., Nanja, D., Carberry, P. and Howden, M., 2008. Building adaptive capacity to cope with increasing vulnerability due to climatic change in Africa–A new approach. *Physics and Chemistry of the Earth, Parts A/B/C*, *33*(8-13), pp.780-787.

UNDP. 2015. Republic of Namibia National Planning Commission: Poverty and Deprivation in Namibia. Report. 16 pp.

Van der Linden, E., 1992. The livestock sector in Namibia. Namibia Review, 1(6), pp.11-13.

Verlinden, A. and Kruger, A.S., 2007. Changing grazing systems in central north Namibia. Land degradation & development, 18(2), pp.179-197.

Vigne, P. and Whiteside, M., 1997. Encouraging sustainable smallholder agriculture in Namibia. Windhoek: Environment and Development Consultancy Limited.

Weber, E.U., 2010. What shapes perceptions of climate change?. Wiley Interdisciplinary Reviews: Climate Change, 1(3), pp.332-342.

West, C.T., Roncoli, C. and Ouattara, F., 2008. Local perceptions and regional climate trends on the Central Plateau of Burkina Faso. Land Degradation & Development, 19(3), pp.289-304.

Whitmarsh, Lorraine (2008) Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. Journal of Risk Research. [Online] 11 (3), 351–374.

Wilhelm, M., 2013. Impact of climate change in Namibia: A case study of Omusati region (Doctoral dissertation).

Williams F-N. 1991. Precolonial communities of southwestern Africa: a history of Aawambo Kingdoms, 1600–1920. Archeia 16:1–204

Williams, F.N., 1991. Precolonial communities of southwestern Africa: a history of Aawambo kingdoms, 1600-1920. National Archives of Namibia.

Wren, S. and Speranza, C.I., 2010. The struggle to diversify rural livelihoods: bio-enterprise initiatives and their impacts on agro-pastoralists and pastoralists communities in the drylands of Kenya. The European Journal of Development Research, 22(5), pp.751-769.

Yamba, S., Appiah, D.O., Pokuaa-Siaw, L. and Asante, F., 2017. Smallholder Farmers' Livelihood Security Options amidst Climate Variability and Change in Rural Ghana. *Scientifica, 2017*.

Yaro, J.A., 2006. Is deagrarianisation real? A study of livelihood activities in rural northern Ghana. The Journal of Modern African Studies, 44(1), pp.125-156.

Zampaligré, N., Dossa, L.H. and Schlecht, E., 2014. Climate change and variability: perception and adaptation strategies of pastoralists and agro-pastoralists across different zones of Burkina Faso. *Regional Environmental Change*, *14*(2), pp.769-783.

Ziervogel, G. and Calder, R., 2003. Climate variability and rural livelihoods: assessing the impact of seasonal climate forecasts in Lesotho. Area, 35(4), pp.403-417.

Appendix A: Ethical Consideration Form

African Climate & Development Initiative

GEOLOGICAL SCIENCE BUILDING, RESEARCHERS Nivedita Joshi

UNIVERSITY OF CAPE TOWN

PRIVATE BAG

RONDEBOSCH 7701 TELEPHONE: +27 (0) 21 650 2838
SOUTH AFRICA

E-MAIL: dian.spear@uct.ac.za

Informed Voluntary Consent to Participate in Research Study

Project Title: Understanding mobility as a livelihood strategy in Omusati Region, Namibia

Invitation to participate, and benefits: You are invited to participate in a research study conducted with rural communities in Omusati region. The study aim is to develop understanding about the impacts of weather on rural lives and some of the problems facing communities like yours. I believe that your experience would be a valuable source of information, and hope that by participating you may gain useful knowledge.

Procedures: During this study, you will be asked to answer some questions about your family and your family's activities. We will also be asking about some of the problems that your household has faced this year and in the past.

Risks: There are no potentially harmful risks related to your participation in this study.

Disclaimer/Withdrawal: Your participation is completely voluntary; you may refuse to participate, and you may withdraw at any time without having to state a reason and without any prejudice or penalty against you. Should you choose to withdraw, the researcher commits not to use any of the information you have provided without your signed consent. Note that the researcher may also withdraw you from the study at any time.

Confidentiality: All information collected in this study will be kept private in that you will not be identified by name or by affiliation to an institution. Confidentiality and anonymity will be maintained as pseudonyms will be used.

What signing this form means:

By signing this consent form, you agree to participate in this research study. The aim, procedures to be used, as well as the potential risks and benefits of your participation have been explained verbally to you in detail, using this form. Refusal to participate in or withdrawal from this study at any time will have no effect on you in any way. You are free to contact me, to ask questions or request further information, at any time during this research.

I agree to participate in this research (tick one box)

☐ Yes ☐ No _____ (Initials)

_____	_____	_____
Name of Participant	Signature of Participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

Appendix B: Livestock Interview Questions for Master's Thesis

Onesi Constituency Interview Number: _____ Date: _____ Location: _____PART I

QUESTIONS	NONE	TOTAL	MALE	FEMALE
Cattle of all ages				
Cattle less than 6 months				
Cattle 6 months and less than 1 year				
Cattle 1 year and less than 3 years				
Cattle 3 years and less than 10 years				
Beef Cattle				
Cattle for breeding				
Dairy Cows				
Cows that gave milk for the last 12 months				
Cattle for other purposes				
Cattle 10 years and older				
Grand total				
Local breed				
Exotic breed				
Hybrid				
QUESTIONS	NONE	TOTAL	MALE	FEMALE

Goats of all ages				
Goats less than 6 months				
Goats 6 months and less than 1 year				
Goats 1 year and less than 2 years				
Goats 2 years and older				
Goats for meat				
Dairy Goats				
Goats for breeding				
Goats for other purposes				
Grand Total				
Local breed				
Hybrid Exotic				

Number of Cattle by Age and Purpose

Number of Goats by Age and Purpose

QUESTIONS	NONE	TOTAL	MAE	FEMALE
Donkeys less than 3 years				
Donkeys 3 years and older				
Donkeys used for draft purposes				
Donkeys used for transportation				

Donkeys for other purposes				

Number of Donkeys by Age+Purpose

General Overview of Livestock

QUESTIONS	CATTLE	GOATS	DONKEYS
Number of currently owned			
Number kept for other?			
Numbers consumed?			
Numbers stolen?			
Total revenue from sales?			
Who in the household owns the animals?			
Who in the household sells the animals?			
Who in the household takes care of the animals?			

PART II – (Questions to ask Household head, Spouse, Male Members, Female Members, Elders, Children, Herd buys and at Herd Post.)

1. How significant is livestock as a source of livelihood?

_____
_____
_____
_____
_____

2. What is the total value received from selling livestock in the past 12 months?

_____
_____
_____
_____
_____

Categories	Cows	Goats	Donkeys
Water			
Feed			
Dipping			
Vaccinations			
Others			

3. Is it only a cash payment or are you also paid in kind – (eg: barter - vegetable for meat)?

_____
_____
_____
_____
_____

4. How much money do you use for the upkeep of your livestock?

_____
_____
_____

_____

_____

5. Who decides about the use of money on goods or services received?

_____

_____

_____

_____

_____

6. How have recent droughts affected the number of livestock in the past 12 months?

_____

_____

_____

_____

_____

7. Do you think droughts will worsen in the future?

_____

_____

_____

_____

_____

8. Given the current drought, is holding onto livestock still the best option

_____

_____

_____

_____

_____

9. If yes, what are the reasons for this?

_____

_____

_____

_____

_____

10. If not, what are the reasons for this?

_____

_____

_____

_____

_____

11. If you did not have livestock how would you derive your income?

_____

_____

_____

_____

_____

PART III

What are the barriers to selling livestock in terms of:

- Technological knowledge from media information

_____

_____

_____

_____

_____

- Institutional logistics – Government support etc.

_____

_____

_____

_____

_____

- Financial

_____

_____

_____

_____

_____

- Skills

_____

_____

_____

_____

_____

- Education

_____

_____

_____

_____

_____

- Culture

_____

_____

_____

_____

_____

- Markets

_____

_____

_____

_____

_____

ADDITIONAL NOTES: